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BULLETIN No. 7—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

PREPARED UNDER THE DIRECTION OF

L. O. HOWARD,

ENTOMOLOGIST.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1897.

DIVISION OF ENTOMOLOGY.

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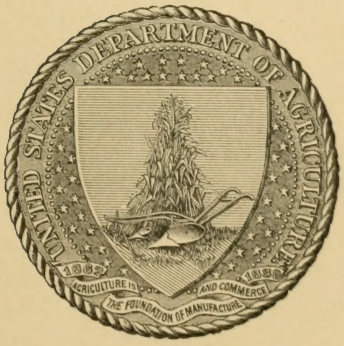

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., January 7, 1897.

SIR: I have the honor to transmit herewith the manuscript of Bulletin No. 7, new series, of this Division. It contains certain articles, reports, and notes which are difficult to classify, but which are all more or less important and well worth immediate publication.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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INTRODUCTION.

When the publication of Insect Life was discontinued with the completion of Volume VII, it was promised that its place would be taken by two series of bulletins, the one technical in its character and the other of more general interest. The general bulletins, it was stated, would comprise short reports on special observations, and others upon the miscellaneous results of the work of the Division in practical and economic lines and in directions of general interest, thus including in the main many of the classes of articles which had been published in Insect Life. The bulletins of this general series so far published will mainly go under the first of these categories. The present bulletin is the first which comes under the second category. Much information of great value to economic and systematic entomologists, and of very considerable general interest as well as of much practical importance, is constantly accumulating in the Division. Such of it as can be used in reports and bulletins upon more or less special subjects is so used. The balance, however, is hard to classify, and yet much of it is no less important. The general notes, for example, and the notes from correspondence, which may seem more or less insignificant themselves, are read with interest and profit by very many persons of different occupations, and it has frequently happened that the first record of a fact or observation of much value has been made in this way. The character of the bulletin can be no more definitely indicated in a title than we have done by the use of the expression "Miscellaneous Results."

L. O. H.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

THE AMBROSIA BEETLES OF THE UNITED STATES.

By H. G. Hubbard.

The term ambrosia beetles is here used as a convenient one to distinguish from the true bark-borers and bark-eaters the timber-boring Scolytidæ, which push their galleries deeply into the wood, and which feed upon a substance called "ambrosia."

Superficially the resemblance between the two groups is very close. They are small elongate beetles, with compact cylindrical bodies, short legs, and dull coloration of varying shades of brown. Although differences in structure exist, these have not hitherto been considered of sufficient importance to warrant their separation into different families.

Although in external form the bark-boring and timber-boring Scolytids resemble each other, in their habits and mode of life they have little in common. The entrances to their galleries in the outer rind of trees are precisely similar, and the designation "shot holes" would be equally descriptive of either group. The variations in diameter are very well covered by the different sizes of small shot. An examination of the galleries into which these openings lead reveals at once the widely different character of the two groups.

The galleries of the bark-borers are superficial and lie within or just under the bark. The galleries of the ambrosia-eating beetles penetrate into the wood, and in all their ramifications are of uniform size and free from wood dust or other refuse.

Their food consists not of wood, but of certain minute and juicy fungi propagated on the walls of their galleries. The action of the fungus produces a stain in the wood, giving to the galleries the appearance of having been bored with a red-hot wire. These characteristic "black holes" serve to distinguish their work from that of all other deep-boring timber beetles.

The ambrosia beetles, in the care which they give their young, exhibit characteristics utterly foreign to most Coleoptera, and such as are usually attributed only to the social Hymenoptera and Neuroptera.

In the species belonging to Platypus and Xyleborus the female deposits her eggs loosely in the galleries or brood chambers, and young and old live together socially in the same quarters.

. The species belonging to the genera Corthylus, Monarthrum, Xyloterus, and Gnathotrichus rear their young in separate pits, which the larvæ never leave until they transform to perfect insects.

The nature of the food of the timber-boring Scolytidæ has always been a matter of considerable uncertainty and mystery. Schmidberger first, in 1836, treating of *Xyleborus dispar*, declared that the food consists of a substance coming from the wood and elaborated by the mother beetle to form "a kind of ambrosia." Subsequently Ratzeburg, Altum, Eichhoff, and others confirmed the observations of Schmidberger, but added only vague speculations as to the nature of his "ambrosia."

In 1844 Theo. Hartig published an article on the ambrosia of *Xyleborus* (*Bostrichus*) *dispar*, in which he showed that it was a fungous growth (pilzrasen) and he named the fungus *Monilia candida*.[1]

The subsequent speculations of various authors have added nothing to our knowledge. In fact, until quite recently, Hartig appears to have been the only writer who has taken the trouble to make a microscopic examination of the so-called ambrosia. In a later writing (1872) upon two species of Xyloterus, the one living in fir and the other in beech wood, the same author states that two distinct kinds of fungus are connected with these two sorts of wood. In 1895 R. Göthe[2] published an excellent figure of the ambrosia of *Xyleborus dispar*.

The correctness of Theo. Hartig's and Göthe's observations may be easily verified. A small fragment of ambrosia taken from the gallery of any species of these timber beetles, if placed on a glass slide, with a drop of water or glycerine and examined with an objective of moderate power, is plainly seen to be a fungus. It will be found, however, that the different kinds of ambrosia fungi are connected with certain species of the beetles irrespective of the sort of timber in which the galleries are constructed. So far as we yet know the food of each species of ambrosia beetles is limited to a certain kind of ambrosia, and only the most closely related species have the same food fungus.

Two principal types exist among the varied forms of these minute fungi: (1) Those with erect stems, having at the terminations of the stems or their branches swollen cells (conidia; figs. 4, 20, 23). (2) Those which form tangled chains of cells, resembling the piled-up beads of a broken necklace (figs. 6, 26, 32). The erect or stylate forms are found among those species of the beetles whose larvæ live free in the galleries (Platypus and Xyleborus). The bead-like or moniliform kinds appear to be peculiar to the species whose larvæ are reared in separate cells or cradles (Corthylus, Monarthrum, etc.).

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[1]Allgemeine Forst -und Jagdzeitung, B. 13, p. 73.

[2]Bericht d. kgl. Lehranstalt für Obst-, Wein -und Gartenbau zu Geisenheim, 1894-95 (1895), p. 25. See also Dr. E. F. Smith in Amer. Nat., vol. 30, 1896, p. 319.

All the growing parts of the fungus are extremely succulent and tender. The conidia especially are always pellucid, and glisten like pearls or like drops of dew. When the plant is in active growth, conidia are produced in the greatest abundance, growing sometimes singly, at the end of short straight stems, as in figs. 20 and 23, sometimes in grape-like clusters among interlacing branches, as seen in fig. 4. At such periods the fungus appears upon the walls of the galleries like a coating of hoarfrost. The young larvæ nip off these tender tips as calves crop the heads of clover, but the older larvæ and the adult beetles eat the whole structure down to the base, from which it soon springs up afresh, appearing in little white tessellations upon the walls.

The growth of ambrosia may in fact be compared to asparagus, which remains succulent and edible only when continually cropped, but if allowed to go to seed is no longer useful as food. In like manner the ambrosia fungus must be constantly kept in fresh growth, otherwise it ripens; its cells burst and discharge the protoplasmic granules which they contain in myriads, and the entire plant disappears as if overwhelmed by a ferment.

Various disturbances of the conditions necessary to its growth are apt to promote the ripening of the fungus, and this is a danger to which every colony of ambrosia beetles is exposed. If through any casualty the natural increase of a populous colony is checked, there results at once an overproduction of the ambrosia. It accumulates, ripens, and discharges its spores, choking the galleries and often suffocating the remaining inhabitants in their own food material. The same results may sometimes be brought about by closing the outlets of the galleries through the bark, or by spraying into them kerosene or some other noxious liquid. The inmates of the colony are thereby thrown into a panic, the beetles rush hither and thither through the galleries, trampling upon and crushing young larvæ and eggs, breaking down the delicate lining of ambrosia on the walls of the brood chambers and puddling it into a kind of slush, which is pushed along and accumulated in the passage ways, completely stopping them in places. The breaking down of the food fungus follows and in a few days the galleries are filled with a paste-like mass of granules or spores, or with threads of mycelium, in which the living insects are suffocated and destroyed.

The ambrosia does not make its appearance by accident or at random in the galleries of the beetles. Its origin is entirely under the control of the insect. It is started by the mother beetle upon a carefully packed bed or layer of chips, sometimes near the entrance, in the bark, but generally at the end of a branch gallery in the wood. In some species the ambrosia is grown only in certain brood chambers of peculiar construction. In others it is propagated in beds, near the cradles of the larvæ. The excrement of the larvæ is used in some and probably in all the species to form new beds or layers for the propagation of the fungus.

It is not alone, however, the excreta of the living beetles or their young that is required for the development of ambrosia; there must be present a certain amount of moisture or sap, and the sap in most species must be in a condition of fermentation. Certain ambrosia beetles, as for example the species of Corthylus, seem not to need fermentation in the propagation of their fungus; their galleries are constructed in the sapwood of vigorous plants. The great majority of the species, however, attack the wood of such trees only as are moribund; in which the natural circulation of the sap has ceased, and fermentation has begun. Some of the number are also able to produce their food fungus in wood which is saturated with a vinous or alcoholic ferment, and they attack wine and ale casks, perforating the staves with their galleries and causing serious loss by leakage.

The precarious conditions under which their food is produced limit the life of a colony of ambrosia eaters in most cases to a single generation.

Under favorable conditions, and in large tree trunks, colonies may continue their excavations during two or three generations before the failure of the sap or change in its condition puts an end to their existence and forces the adult beetles to seek new quarters.

When their galleries are disturbed and opened to daylight, the adult beetles generally fall to eating their ambrosia as rapidly as possible. Like other social insects they show their concern at the threatened loss of their most precious possession and try to save it, just as bees, when alarmed, fill themselves with honey.

As its honey is to the bee, so to the ambrosia-feeding beetle its food fungus is the material the propagation and preservation of which is the chief concern of its life. Its solicitude concerning it is not surprising when one considers the herculean labors which it undergoes in the effort to produce it, the frequent failures, and the difficulties and uncertainties that at all times attend its preservation in the vegetative form, in which alone it can serve the insect as food.

INJURIES CAUSED BY AMBROSIA BEETLES.

To living plants.—As a rule, populous colonies of these beetles and galleries so numerous and extensive as to be capable of doing serious harm are found only in trees, which before the attack began were sick unto death with maladies for which the timber beetles are in nowise responsible. The few species which enter the sapwood of vigorous trees do not form large colonies, and the effect upon the health of the tree is not appreciable. One or two species, it is true, have the habit of sapping the life of twigs or small branches with an encircling burrow, and a species of Corthylus does considerable injury in this way to young trees and to shrubbery in the forest.

Injuries to timber.—The defects in wood caused by the galleries and

the stains left by ambrosia beetles probably entail more serious losses than their direct attacks upon living trees.

The majority of the species confine their depredations to the sapwood of recently felled or dying trees. They therefore affect injuriously the least valuable portion of the wood. On the other hand, some of the larger and stronger species are capable of entirely destroying for any useful purpose except for fuel the timber of the largest trees. Their borings penetrate the heartwood in every direction and riddle it with holes.

Occasional black holes and stains left by these beetles in the heartwood of timber otherwise sound reduce its grade and its value in the market, and render it unfit for use where the full strength of the material is required, as, for example, in the framework of buildings and the construction of wagons, agricultural implements, etc. But for some other purposes, as for furniture and inside finishing lumber, it is not necessarily deteriorated.

The damage to timber intended for use as cask headings, staves, shingles, and the like is very serious. Cask makers frequently repair the damage when not too extensive by closing the holes with wooden pins. The holes made by certain species of timber beetles can not be plugged, but in most cases, owing to the uniform system followed by each species in constructing its galleries, a particular method of sawing is capable of reducing the damage to a minimum and of effecting a very considerable saving of material.

REMEDIES.

From what has been said of the nature of the food of these beetles, it is evident that any method by which the entrances to their galleries in the bark can be closed will effectually put an end to the progress of their colonies.

Perhaps the best means of accomplishing this is by coating the trunks with dendrolene or raupenleim. A light brushing or spraying of the bark with creosote or kerosene will sometimes accomplish the same result, especially at the beginning of an attack. But this can not be depended upon to permanently protect the trees.

Valuable fruit trees which have suffered injury from fire or frost can not always be protected from attacks of the borers by coating the bark, because of the risk of injury to the buds, which must be allowed to grow upon the trunks. In such cases, if borers enter the wood their holes must be plugged. An excellent method is to insert an iron wire as far as it will go, cut it off and leave the piece in the hole. The inhabitants of colonies thus imprisoned are unable to extend their borings and inevitably perish.

The species of this genus are among the largest, strongest, and most destructive of the ambrosia beetles in the United States. They are readily known by their very long cylindrical bodies, their prominent heads, flattened in front, the flattened and spur-tipped joint of the front legs, and in the males the spine-like projections of the wing-cases behind.

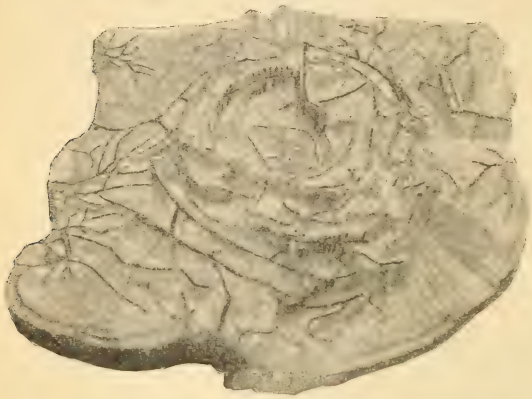

FIG. 1.—Section of an orange trunk, showing galleries of *Platypus compositus*—greatly reduced (original).

They are powerful excavators, generally selecting the trunks of large trees, and driving their galleries deep into the heartwood. The section of an orange trunk shown in fig. 1 indicates how extensive their galleries sometimes become.

The female is frequently accompanied by several males, and as they are savage fighters, fierce sexual contests take place, as a result of which the galleries are often strewn with the fragments of the vanquished. The projecting spines at the end of the wing-cases are very effective weapons in these fights. With their aid a beetle attacked in the rear can make a good defense and frequently by a lucky stroke is able to dislocate the outstretched neck of his enemy.

The females produce from 100 to 200 elongate-oval pearl-white eggs, which they deposit, in clusters of 10 or 12, loosely in the galleries.

The young require five or six weeks for their development. They wander freely about in the passages and feed in company upon the ambrosia which grows here and there upon the walls. The adult larva is represented in fig. 2 (lower fig.), while fig. 3 (upper fig.) exhibits in greatly enlarged detail the chitinous ridges upon the thoracic segment. These ridges, together with the row of tubercles upon the other segments, enable the larva to move as rapidly through the galleries as if it were possessed of well-formed legs. The details of the mouth parts seen in fig. 3 show that

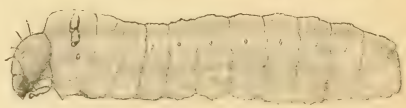

FIG. 2.—*Platypus compositus:* Upper figure, imago; lower figure, full-grown larva—enlarged (original).

the larva is provided with strong cutting mandibles, but the inner jaws (fig. 3, middle fig.) are not adapted to masticating hard food, such as particles of wood.

The older larvæ assist in excavating the galleries, but they do not eat or swallow the wood. The larvæ of all ages are surprisingly alert, active, and intelligent. They exhibit curiosity equally with the adults, and show evident regard for the eggs and very tender young, which are scattered at random through the passages, and might easily be destroyed by them in their movements. If thrown into a panic the young larvæ scurry away with an undulatory movement of their bodies, but the older larvæ will frequently stop at the nearest intersecting passage way to let the small fry pass, and show fight to cover their retreat.

When full grown the larva excavates a cell or chamber into which it retires to undergo its transformations. The pupa cells are cut parallel with the grain of the wood and generally occur, as plainly shown in fig. 1, in groups of 8 to 12 along some of the deeper passages.

The older portions of the galleries are blackened by the long-continued formation of the food fungus.

The ambrosia of *P. compositus* is represented in fig. 4. The conidia are hemispherical, and are borne in clusters upon branching stems.

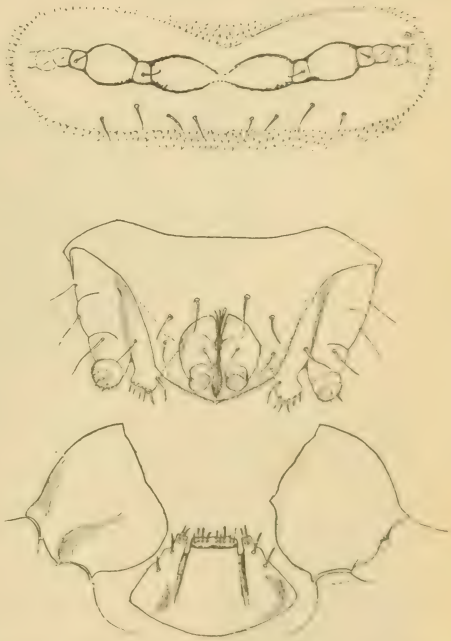

FIG. 3.—Details of larva of *Platypus compositus:* Upper figure, chitinous ridges upon prothoracic segment; middle figure, lower lip with inner jaws (maxillæ); lower figure, mandibles and upper lip—all greatly enlarged (original).

The species of Platypus do not attack trees in health. They are attracted only by the fermenting sap of dying or very badly injured trees. The death rattle is not more ominous of dissolution in animals than the presence of these beetles in standing timber. If the timber attacked by them is to be saved, even for firewood, the sooner it is cut down and seasoned the better.

The family Platypidæ are essentially tropical insects; they abound in Central America. But five or six species, all belonging to the genus Platypus, range northward from Mexico and enter the United States. Three species—*P. compositus* Say, *P. flavicornis* Fab., and *P. quadridentatus* Ol.—are not uncommon in the Southern States, and along the

Atlantic coast to Delaware Bay. Inland they do not extend farther north than West Virginia. The three species differ only in minute

FIG. 4.—Ambrosia of *Platypus compositus*—greatly enlarged (original).

details, and the habits are the same in all. *P. compositus*, represented in fig. 2 (upper fig.), is perhaps our commonest species.

They are not confined to any particular kind of timber, and are as frequently found in conifers as in deciduous trees.

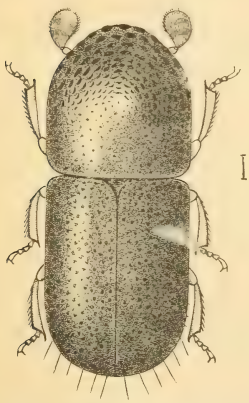

FIG. 5.—*Corthylus punctatissimus* (original).

THE GENUS CORTHYLUS.

In this genus the form is short and stout, the thorax and abdomen are almost equal in size, so that the body appears to be divided in the middle. The surface is smooth and shining; there are no engraved lines or rows of punctures upon the wing-cases, and the color is a deep black. The sexes are alike. All the species attack plants which are in perfect health.

Corthylus punctatissimus Zimm. (fig. 5) is a very common species in the forest region of the Eastern United States. It attacks and kills shrubs and young trees, such as maple, sassafras, dogwood, hazel, ironwood, etc., and is also found in the roots of huckleberry.

The galleries are made in the root and lower part of the crown of the plant, just below the level of the soil. In young trees, an inch or more in diameter, the burrow is circular, and kills the plant by

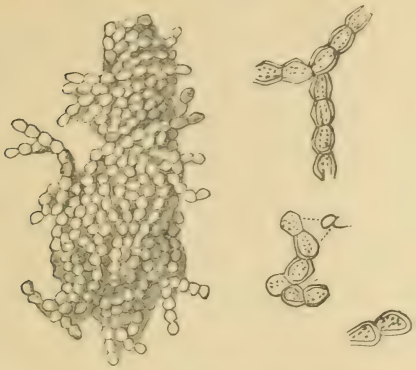

FIG. 6.—Ambrosia of *Corthylus punctatissimus: a*, detached dumb-bell shaped pairs of cell—greatly enlarged (original).

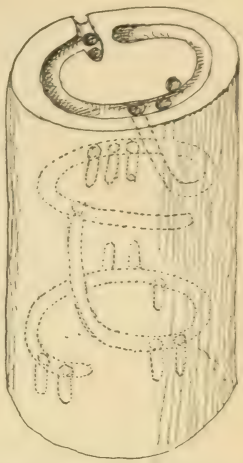

FIG. 7.—Galleries of *Corthylus punctatissimus* in huckleberry roots—enlarged (original).

girdling it. In small shrubs, like huckleberry, the galleries are spiral, as indicated diagrammatically in fig. 7. Short, straight galleries ascend or descend from the primary burrow, following the grain of the wood. These are occupied by the young, and in them, when full grown, the larvæ undergo their transformations. The system sometimes includes a second and more rarely a third circular gallery. Prof. A. D. Hopkins states that in sassafras trees of considerable size he has sometimes found their galleries overgrown by the annual layers and the tree unharmed.

The food fungus, taken from galleries in roots of huckleberry (*Gaylussacia resinosa*), is sketched in fig. 6. It consists of a confused mass of rather large conidia heaped together like fish roe. The cells by mutual pressure lose somewhat their spherical form. Connecting threads are sometimes discoverable, and attached to these short and thick branches which give rise to two or three spherical conidia. At *a* in the figure dumb-bell shaped pairs of these cells are shown detached from the mass. The stain of the fungus is intensely blue-black, and penetrates the wood deeply.

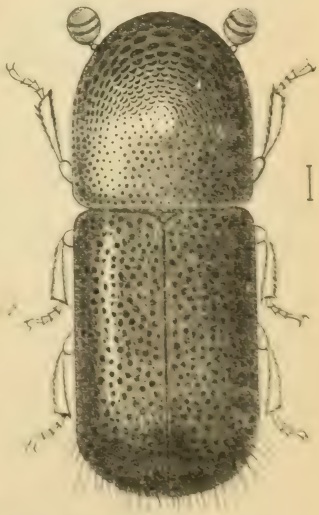

FIG. 8.—*Corthylus columbianus*—enlarged (original).

Corthylus columbianus Hopkins (fig. 8).—The Columbian timber beetle is somewhat larger than the preceding species, which it otherwise

resembles very closely. Its galleries are excavated in the sapwood of perfectly healthy trees. After a short occupancy they are abandoned by the beetles, and, being overgrown by successive annual layers, are ultimately found in the heartwood.

According to Professor Hopkins, successive generations of the beetle make their galleries in the same tree, not materially affecting its vitality, but doing serious injury to the quality of the timber by filling it with defects. The galleries of this species fork once or twice soon after entering the wood. Fig. 9 shows in horizontal section a gallery in yellow poplar. The branches are straight and nearly parallel when the sapwood has a thickness of several inches, but when the sapwood is thin they diverge and curve more or less to avoid entering the heartwood. The larvæ are raised in separate brood cells or cradles, which set off from the main gallery at a considerable angle, as shown diagrammatically in fig. 9.

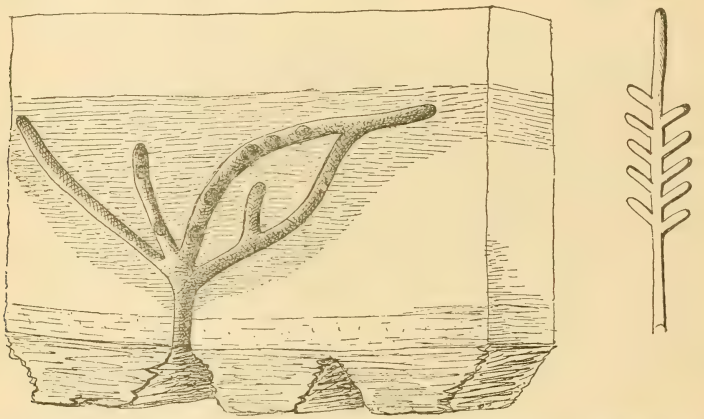

FIG. 9.—Galleries of *Corthylus columbianus* in Liriodendron, with diagram of brood cells (adapted from drawings by A. D. Hopkins).

The number of young raised in oak or beech does not exceed 10 or 12 to a colony. In colonies from yellow poplar (Liriodendron) their number is somewhat greater. The mature beetles probably remain over winter in the galleries. The following spring they issue forth and make new galleries in the immediate vicinity of the old. The food fungus of *C. columbianus* has not been examined. It leaves, however, an intensely black stain which in soft wood extends with the grain several feet upward and downward from the galleries. Of the geographical distribution of this recently discovered beetle very little is known. All our knowledge of its habits we owe to the studies made by Professor Hopkins in West Virginia. He has also observed defects, attributed to this species, in lumber from Michigan. A specimen of the beetle was found by Mr. E. A. Schwarz on the shore at Fortress Monroe, Va., and a specimen in the cabinet of Mr. Ulke bears the label Massachusetts. From these indications it may be surmised that the species is as widely distributed as *C. punctatissimus*.

THE GENUS XYLEBORUS.

This genus embraces a large number of species, the classification of which presents great difficulties, and is at present in much confusion. The females in some groups are nearly indistinguishable, and although the males present recognizable differences, they are in most of the species entirely unknown. The males differ remarkably from the females; they are wingless, and often very much smaller. They are, moreover, much less numerous than the females, and, as they seldom leave the galleries in which they were born, are very rarely collected.

FIG. 10.—*Xyleborus pubescens*: Female and male—enlarged (original).

The "pubescens" group.—Fig. 10 represents, respectively, the male and female *Xyleborus pubescens* Zimm. Under this name are confused the females of several species which have the same habits.

A solitary female starts the colony, the plan of which is given in fig. 11. The branches serve as brood galleries, and in each are deposited 5 or 6 oval pearly eggs. The young hatch out within a week and begin at once to feed upon the ambrosia, which glistens upon the walls like hoarfrost. The pupæ are formed lying free in the galleries, and in somewhat over a month from the egg the perfect beetles make their appearance. In time the colony contains, besides the mother insect, 15 or 20 of her offspring which have become adult. Nearly all of these will be females. Only one or two males are commonly found in a colony. The males fertilize their brood sisters within the galleries, and by them a second generation may be started. But usually the seasoning of the wood and the threatening failure of food fungus warn the young females to depart and seek fresher tree trunks in which to found new colonies.

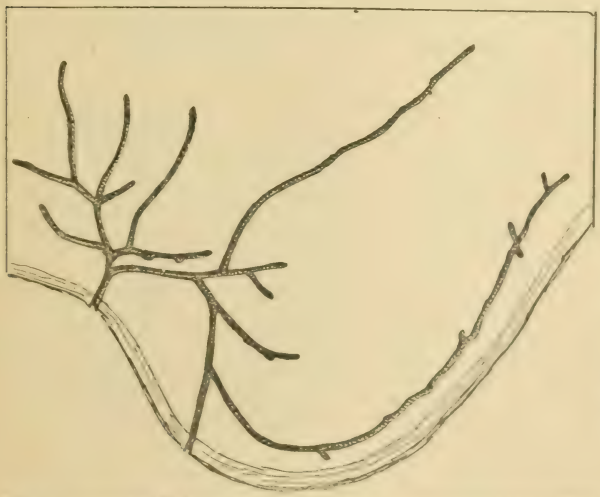

FIG. 11.—Gallery of *Xyleborus pubescens* in orange—natural size (original).

The swarming of the females leaves the abandoned males in sad

plight. Since they are unable to consume the rapidly ripening ambrosia, they must also wander forth, although wingless and weak in organi-

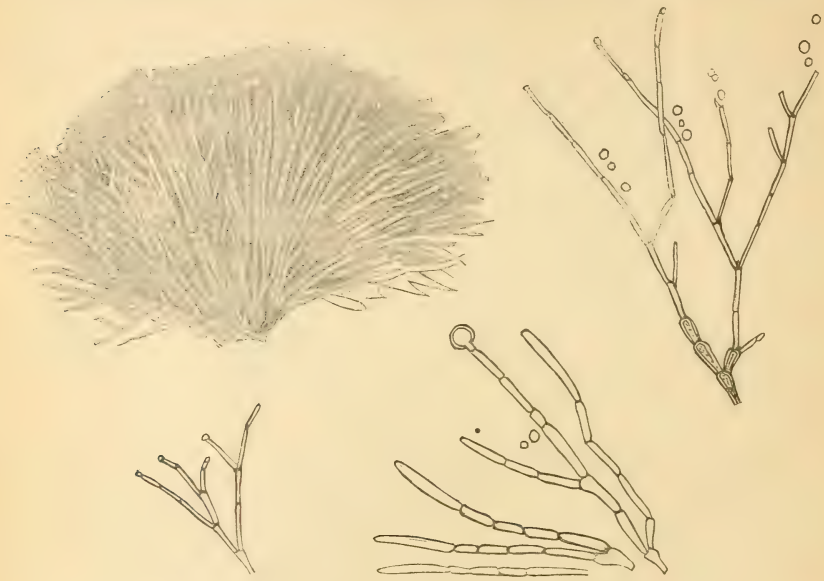

FIG. 12.—Ambrosia of *Xyleborus pubescens* found in maple—greatly enlarged (original).

zation, or perish by suffocation. They therefore frequently assemble in certain galleries to form bachelor colonies, where, by their combined numbers, they are able for a time to prolong their existence. They are found sometimes, as Eichhoff relates, to the number of 50 or 60, packed one behind the other in a single gallery.

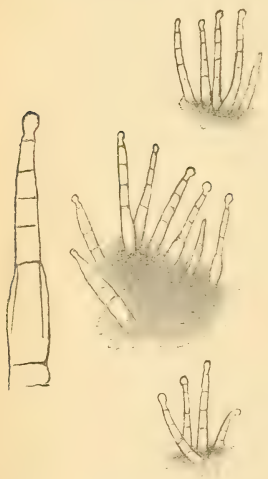

FIG. 13.—Ambrosia of *Xyleborus pubescens* in orange—greatly enlarged (orignal).

The ambrosia of *X. pubescens* has short branching stems, terminated by single spherical conidia. In fig. 12 is shown a form from the gallery of a species belonging to this group, found in maple. Another form of the fungus is given in fig. 13. It was taken from galleries of the typical species in orange wood. A brown stain accompanies the fungus and discolors it at the base of each cluster.

A number of females which can not at present be distinguished from *X. pubescens* Zimm. have been described under the names *X. affinis* Eichh., *X. perforans* Woll., *X. inermis* Eichh., *X. pini* Eichh., and *X. propinquus* Eichh. The names *X. retusicollis* and *X. planicollis* were given by Zimmerman and LeConte to two males which belong to the *pubescens* group.

The species of this group inhabit many kinds of trees. The same

forms which are found in the orange breed also in pine and oak. Their galleries are found also in maple, ash, and other woods. They may be driven by hunger to inflict injuries upon healthy trees, but it is only in the sapwood of dying timber that they succeed in establishing themselves and in raising their young.

Certain species of Xyleborus have been found to injure wine and beer casks, into the staves of which they bore for the purpose of raising their food fungus. It is doubtful if they breed in such situations. *X. perforans* Woll. causes leakage in wine casks. It was described by Wollaston from the Island of Madeira. Mr. F. H. Blandford has identified the specimens preserved in the British Museum with *X. affinis* Eichh., a North American species, but his determination, made from the females only, cannot be reliable. The same species is said by Blandford to cause leakage in wine and ale casks in India and elsewhere.

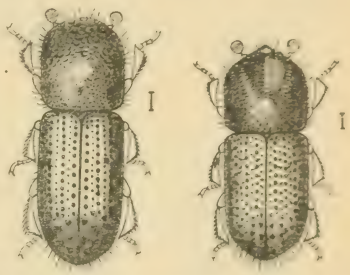

FIG. 14.—*Xyleborus perforans:* Female and male—enlarged (original).

In the Southern United States, leakage of wine in casks is occasioned by several species of Xyleborus, and it is not unlikely that any native species of the genus may be the author of the damage in moist and warm climates.

The notorious "shot-hole borer," which riddles with its burrows the joints of sugar cane and causes lamentable injuries in West Indian plantations, is supposed by Blandford to be identical with the cask borer, *X. perforans*, and with *X. affinis*.

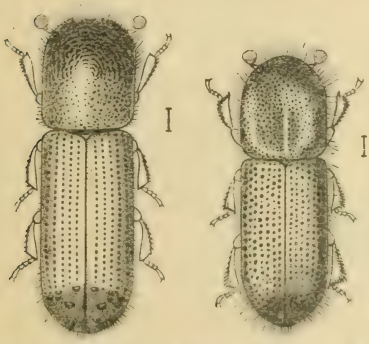

FIG. 15.—*Xyleborus fuscatus:* Female and male—enlarged (original).

The male and female of the sugar-cane borer are represented in fig. 14. It is very probably a distinct and as yet unnamed species, the introduction of which into the United States is greatly to be feared. It can not be identical with *X. affinis*, which is common in the Southern States, yet has never been known to attack sugar cane.

Xyleborus fuscatus Eichh. (fig. 15, female and male).—This species is closely allied to *X. pubescens*, and is frequently associated with it in the same galleries. The females of *X. fuscatus* are, however, readily distinguished by the presence at the end of the elytra of two prominent teeth, which are surrounded by three or four smaller teeth on the edge of the declivity. All other females of the *pubescens* group have three rows of feeble teeth on the declivity of the elytra, with three or

four teeth in each row. According to observations made by Professor Hopkins and Mr. Schwarz, *X. planicollis* Zimm. is pretty certainly the male of *X. fuscatus*.

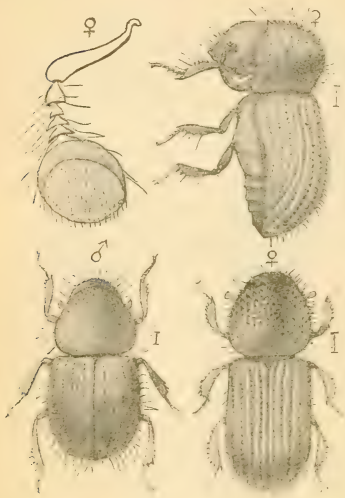

FIG. 16.—*Xyleborus dispar:* Male and female imagos—enlarged, antenna of female more enlarged (original).

The food galleries of this species are excavated in many kinds of trees and also in wine casks, but it breeds chiefly in oak, hickory, and perhaps other hard woods.

FIG. 17.—Gallery of *Xyleborus dispar* in Liriodendron twig: Upper figure, transverse section; lower figure, longitudinal section (after Marx).

The "dispar" group.—Three species, *X. dispar* Fab. (*pyri* Peck), *X. tachygraphus* Zimm., and *X. obesus* Lec., exhibit extreme differences between the sexes. The males are very minute. They have the thorax narrowed in front and the form excessively abbreviated, so that it becomes oval and convex longitudinally.

The species of this group have the habit of making circular galleries in small branches of healthy trees. In larger timber they form branching galleries, as in the *pubescens* group.

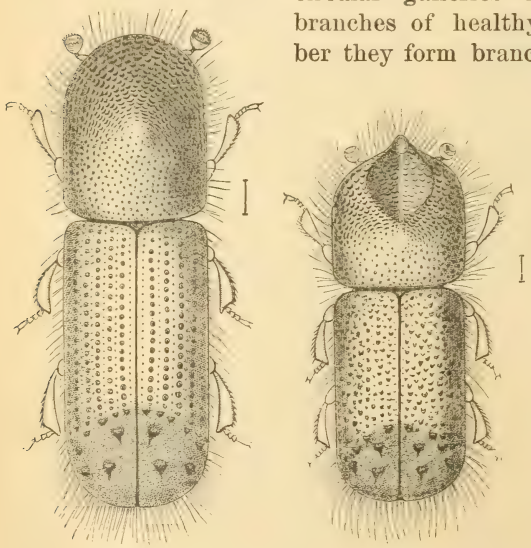

FIG. 18.—*Xyleborus celsus:* Female and male—enlarged (original).

Xyleborus dispar Fab. (fig. 16) is an extremely injurious insect both in Europe and America. According to Eichhoff it lives in almost any kind of tree, including conifers. In this country its injuries to fruit trees have been noted by many writers, beginning with Peck in 1817, who described it, under the name (*X.*) *pyri*, as destructive to branches of pear young trees.

In fig. 17 is shown the gallery which the female makes, encircling the

pith of smaller branches of fruit trees, and the perpendicular brood chambers which ascend or descend from the main gallery parallel with the grain of the wood. Branches thus girdled are killed beyond the point of attack, and the trimming of the trees is frequently so severe that the damage is attributed to lightning.

Pear and apple trees suffer from its attacks from Nova Scotia southward. It also girdles and kills young trees of many kinds which have been injured by fire. Professor Hopkins reports it from West Virginia in hemlock, oak, etc., and says that it enters the sapwood and heartwood of freshly cut logs of all sorts.

Xyleborus tachygraphus Zimm. is a rather more slender species than

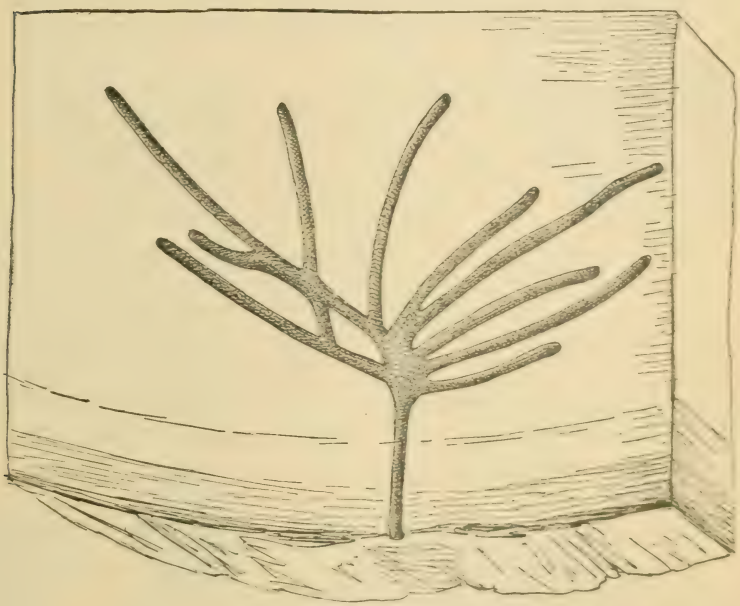

FIG. 19.—Gallery of *Xyleborus celsus* in hickory (original).

the preceding. It has been found by Mr. Schwarz near the District of Columbia girdling the shoots of Liriodendron in the same way as *X. dispar*, and Mr. Chittenden has found it also upon box-elder, red-bud, maple, beech, and sumac. It ranges from New Hampshire to North Carolina, but has not been found west of the Alleghany Mountains.

Xyleborus obesus Lec. is not readily distinguished from *X. dispar*. According to Professor Hopkins, in West Virginia it inhabits oak, beech, hemlock, etc., and makes large black pinholes in the greenwood

of logs. It has been found in Ontario, Canada, in freshly cut maple stumps.

Xyleborus celsus Eichh. (fig. 18, female and male).—This is the largest American species of the genus. It has been found only in hickory trees. The galleries, shown in fig. 19, have a short entrance passage, from the end of which numerous branches radiate in a nearly horizontal plane. They penetrate deeply into the heartwood and greatly promote decay in the timber. The galleries are blackened as if by fire, but the stain does not extend deeply into the wood.

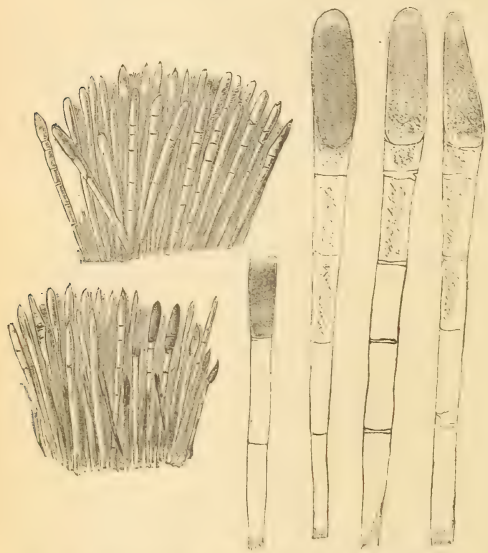

FIG. 20.—Ambrosia of *Xyleborus celsus*—greatly enlarged (original).

The ambrosia, fig. 20, consists of club-shaped stems growing upright in dense clusters. The joints are long, and the terminal conidia when they separate are several times longer than wide. An umber-brown discoloration tinges the base of the clustered stems, but their terminations are pellucid and filled with colorless protoplasmic granules.

The young and adults of the beetles live socially in the galleries and the pupæ are formed lying free in the passages.

The male of *X. celsus* was described by LeConte under the name of *X. biographus.*

Xyleborus xylographus Say (=*saxeseni* Ratz.) (fig. 21).—This is a slender elongate species, which can be distinguished from all others by the very regular rows of small but sharp teeth upon the declivity of the elytra.

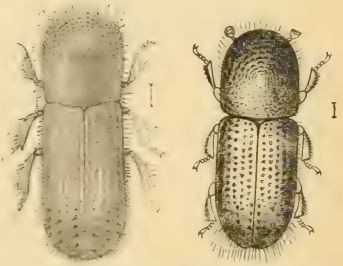

FIG. 21.—*Xyleborus xylographus:* Female and male—enlarged (original).

The young in this species are assembled in a brood chamber, the usual form of which is represented in fig. 22. It is constructed at the end of a gallery which penetrates deeply into the heart, or remains in the sapwood, according to the amount of moisture in the tree trunk. The chamber is somewhat leaf-shaped, and stands vertically on edge, parallel with the grain of the wood. The space between the walls is not much greater than the

thickness of the bodies of the adult beetles. The larvæ of all ages are able to cling to the vertical walls, and to progress over them by an adaptation of the end of the body which aids them in progression.

The entire surfaces of the walls in the brood chamber are plastered over with ambrosia fungus, a representation of which is given in fig. 23. It consists of short erect stems, terminating in spherical conidia.

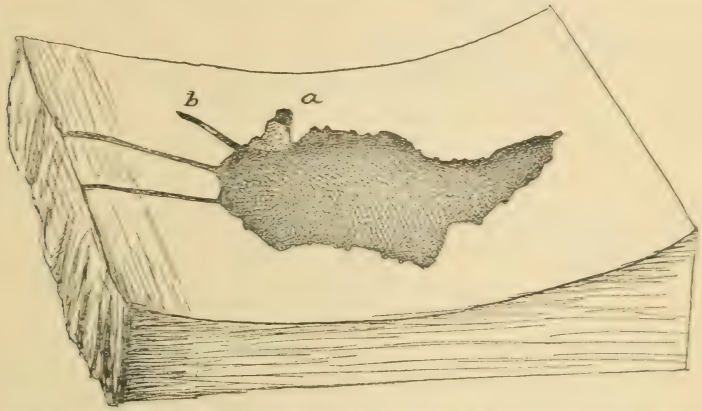

FIG. 22.—Gallery of *Xyleborus xylographus* in hickory: *a*, *b*, death chambers (original).

The freshly grown fungus is as colorless as crystal, but it is usually more or less stained with greenish-yellow, and sometimes resembles a coating of sublimed sulphur. The brood chamber is packed at times with eggs, larvæ, pupæ, and adults in all stages of maturity. The larvæ aid in extending the brood chamber. They swallow the wood which they remove with their jaws, and in passing through their bodies it becomes stained a mustard-yellow color. Great quantities of this excrement are ejected from the openings of the colony, but a portion is retained and plastered upon the walls, where it serves as a bed upon which there springs up a new crop of the food fungus.

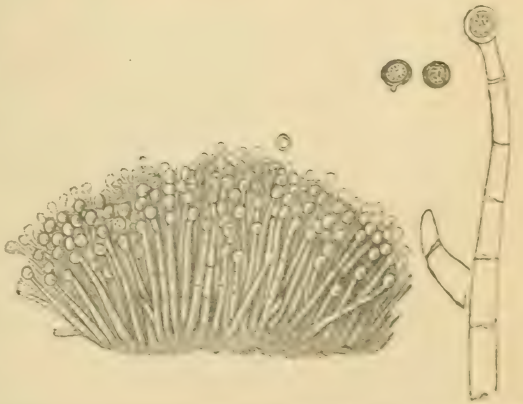

FIG. 23.—Ambrosia of *Xyleborus xylographus*—greatly enlarged (original).

In populous colonies it is not unusual to find the remains of individuals which have died packed away in a deep recess of the brood chamber and carefully inclosed with a wall of chips. In fig. 22, at *a*, is shown such a catacomb, which was found to contain the mutilated

bodies of a dozen or more larvæ and immature imagoes, together with the fragments of a predatory beetle, *Colydium lineola* Say. This tomb bears testimony to a sanguinary conflict, in which victory crowned the efforts of the ambrosia eaters. The bodies of the slain, both friend and foe, have been consigned to the same sepulcher. In the same figure, at *b*, is shown a short branch gallery containing the lifeless body of the mother of the colony, who appears to have constructed her own tomb and to have crawled into it as she neared her end. The mouth of this tomb also has been sealed up by the survivors.

Xyleborus xylographus breeds only in dying trees, and generally in trunks of large size. It appears to be partial to rather hard woods, like oak, hickory, beech, and maple, and is found wherever these trees grow, both in this country and in Europe. It does much injury to timber, and in cut lumber the broad, flat chambers produce defects which can not be remedied by plugging.

THE GENUS MONARTHRUM.

In this genus the sexes are alike, and the males assist the females in forming new colonies. The young are raised in separate pits or cradles, which they never leave until they reach the adult stage. The galleries, constructed by the mature female beetles, extend rather deeply into the wood, with their branches mostly in a horizontal plane (figs. 24 and 25).

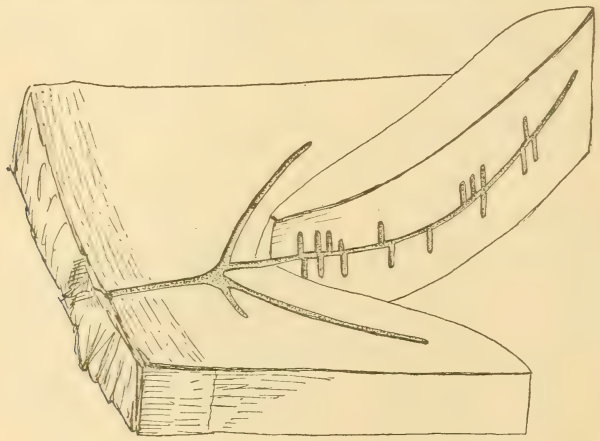

FIG. 24.—Gallery of *Monarthrum fasciatum* in maple (original).

The mother beetle deposits her eggs singly in circular pits which she excavates in the gallery, in two opposite series, parallel with the grain of the wood. The eggs are loosely packed in the pits with chips and material taken from the fungus bed which she has previously prepared in the vicinity and upon which the ambrosia has begun to grow.

The young larvæ, as soon as they hatch out, eat the fungus from these chips and eject the refuse from their cradles. At first they lie curled up in the pit made by the mother, but as they grow larger, with

their own jaws they deepen their cradles, until, at full growth, they slightly exceed the length of the larva when fully extended. The larvæ swallow the wood which they excavate, but do not digest it. It passes

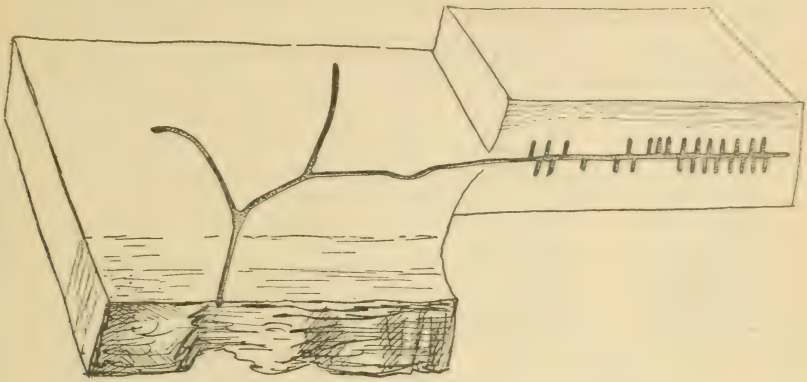

FIG. 25.—Gallery of *Monarthrum mali* in maple (original).

through the intestines unchanged in cellular texture, but cemented by the excrement into pellets and stained a yellowish color. The pellets of excrement are not allowed by the larvæ to accumulate in their cradles, but are frequently ejected by them and are removed and cast out of the mouth of the borings by the mother beetle. A portion of the excrement is evidently utilized to form the fungus garden bed. The mother beetle is constantly in attendance upon her young during the period of their development, and guards them with jealous care.

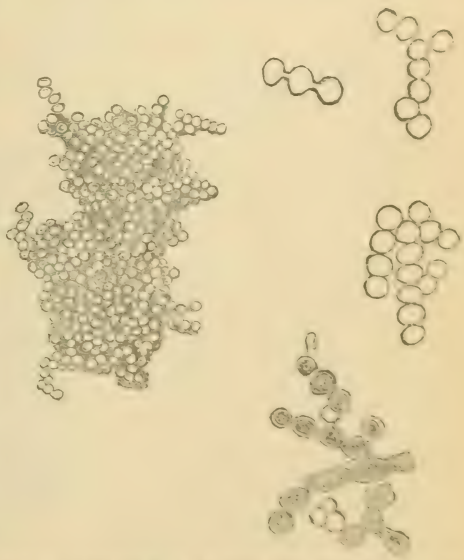

FIG. 26.—Ambrosia of *Monarthrum mali*—greatly enlarged (original).

The mouth of each cradle is closed with a plug of the food fungus, and as fast as this is consumed it is renewed with fresh material. The larvæ from time to time perforate this plug and clean out their cells, pushing out the pellets of excrement through the opening. This débris is promptly removed by the mother and the opening again sealed with ambrosia. The young transform to perfect beetles before leaving their cradles and emerging into the galleries.

The ambrosia of Monarthrum (fig. 26) is moniliform, like that of Corthylus, and resembles a mass of pearly beads. In its incipient stages

a formative stem is seen, which has short joints that become globular conidia and break apart. Short chains of cells, sometimes showing branches, may often be separated from the mass. The base of the fungus mass is stained with a tinge of green, but the stain in the wood is almost black.

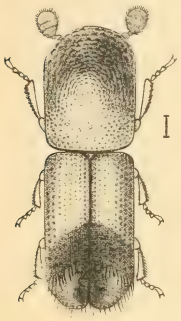

FIG. 27.—*Monarthrum fasciatum*—enlarged (original).

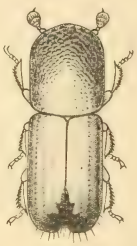

FIG. 28.—*Monarthrum mali*—enlarged (original).

Two species, *Monarthrum fasciatum* Say (fig. 27) and *M. mali* Fitch (fig. 28), are confined to the Atlantic forests and range in latitude from Lake Superior to Florida. They have identical habits and feed upon the same fungus. They are commonly associated in the same tree trunk, and not seldom occupy galleries having a common entrance hole. Both species are known to attack wine casks, but they probably breed only in dying trees.

The trees attacked include oak, hickory, beech, maple, aspen, apple, and orange, and the list might be extended to include hard-wood timber.

Monarthrum scutellare Lec. and *M. dentiger* Lec. are Western species of which little is known, except that they have been found in oak timber.

THE GENUS XYLOTERUS.

As in Monarthrum, the males accompany the females in their flight. The young are raised also in separate cradles.

Xyloterus bivittatus Kirby (fig. 29) is common in coniferous trees from Alaska to Maine, and extending southward in mountainous regions. It is equally common in Northern Europe.

Xyloterus politus Say (fig. 30) is a smaller, smoother, and unicolorous species infesting the sapwood of deciduous as well as of coniferous trees. It has a wide distribution in the diversified forest region of the Eastern United States. Mr. Schwarz has shown that its attacks may sometimes prove fatal to trees not in vigorous health. It is a dangerous enemy to smooth-barked trees whenever they become weakened by external injuries or shaken by storms.

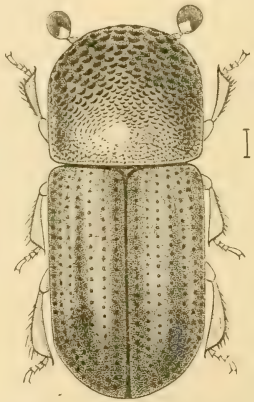

FIG. 29.—*Xyloterus bivittatus*—enlarged (original).

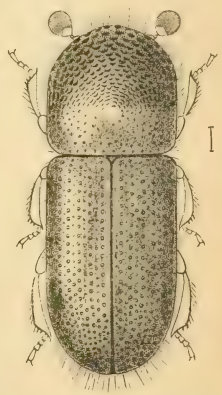

FIG. 30.—*Xyloterus politus*—enlarged (original).

Observations made upon maple trees at Washington, D. C., show that

it sometimes fails to establish colonies in such trees, through inability to raise its food fungus.

Xyloterus retusus Lec.—This is the largest of the ambrosia beetles, and resembles very closely *X. bivittatus*, which has been illustrated in fig. 29. The species has been found only in the broad-toothed aspen (*Populus grandidentata*), and occurs in northern regions, following probably the distribution of that tree. Professor Hopkins records it also from West Virginia.

The galleries of this species are represented in fig. 31. Several pairs of the beetle unite in colonies having a single entrance, but each family occupies its own quarters, consisting of one or two branch galleries. The galleries do not penetrate deeply into the heartwood.

Each female attends her own brood, which are raised in cradles extending upward and downward at right angles to the main passageway. She feeds the young with a yellowish ambrosia grown in beds in the neighborhood of the cradles. The mouth of each cradle is constantly kept filled with a plug of the food fungus.

The ambrosia, represented in fig. 32, consists of oval cells which form upright sticks resembling some forms of styliform ambrosia, but they do not branch and are capable of being broken up into bead-like masses without losing their vegetative powers.

Although the color of the fungus bed is yellowish, the galleries are stained intensely black.

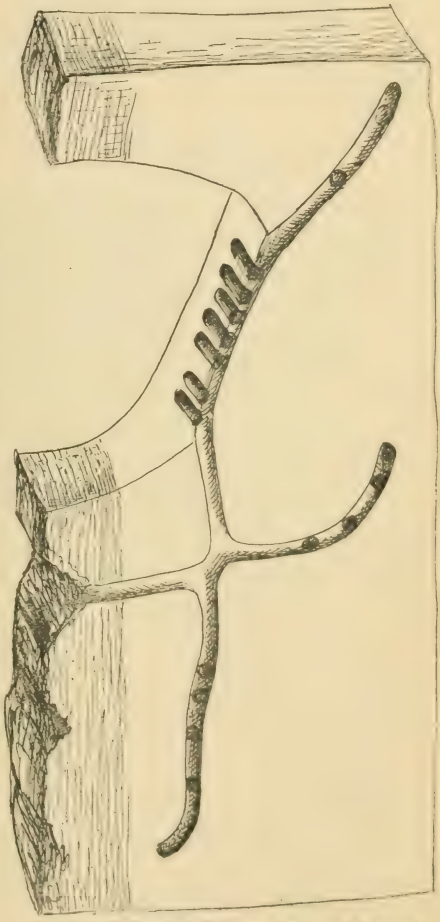

FIG. 31.—Gallery of *Xyloterus retusus* in aspen (original).

Xyloterus scabricollis Lec.—This is a rare species described from the District of Columbia. Professor Hopkins records it as infesting pines in West Virginia.

In Europe a number of species of Trypodendron, the generic name being synonymous with Xyloterus, are known to cause defects in timber of many kinds, including oak and other hard woods. They push their galleries deeply into the heartwood and raise their young in separate cradles in the manner previously described.

According to Mr. Blandford, the defects caused by one or more species

of this genus in the timber from which casks are made are sometimes responsible for leakages in casks imported from Europe into India.

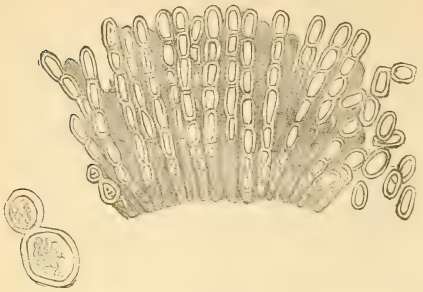

FIG. 32.—Ambrosia of *Xyloterus retusus*—greatly enlarged (original).

THE GENUS GNATHOTRICHUS.

The males are distinguished from the females by the stronger development of tubercles or teeth at the end of the body. The young are raised in cradles, as in Monarthrum and Xyloterus.

The only species of the genus whose habits are known is *Gnathotrichus materiarius* Fitch (fig. 33), of which Asa Fitch gave a brief account in 1857. He gave a diagram of a gallery, which shows cradles extending upward and downward parallel with the grain of the wood. His specimens were found in pine wood. Professor Hopkins also enumerates this species in his catalogue of Scolytidæ of West Virginia, and notes that it causes "bluing" of the wood, which is characteristic of the ambrosia-feeding beetles. He has prepared a careful drawing of the gallery from which the accompanying figure 34 has been adapted. There are two other species in our fauna, of which little is known.

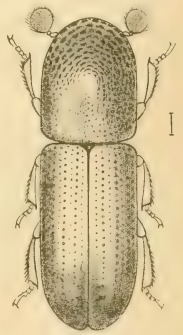

FIG. 33.—*Gnathotrichus materiarius* (original).

Gnathotrichus asperulus Lec., a small species resembling the twig

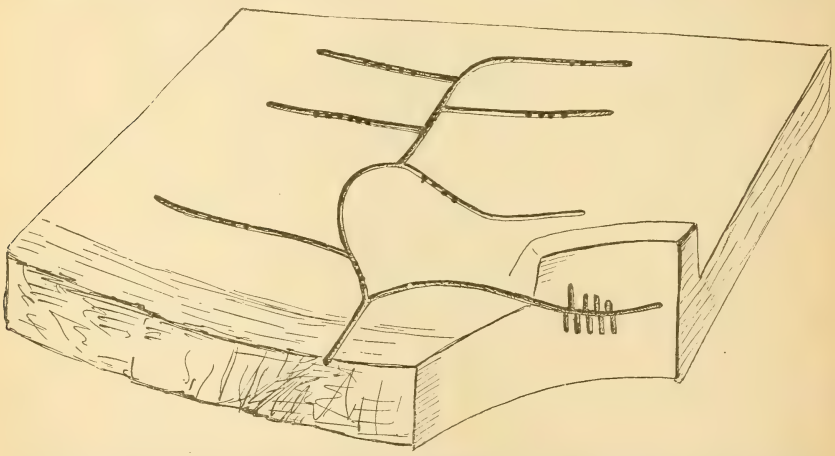

FIG. 34.—Gallery of *Gnathotrichus materiarius* in pine (adapted from an unpublished drawing by Prof. A. D. Hopkins.)

borers (Hypothenemus), is found in the Eastern United States and is a rare insect.

G. retusus Lec. is Californian. All the species live in pine trees.

GRASSHOPPER REPORT FOR 1895.[1]

By Lawrence Bruner, *Temporary Field Agent.*

In accordance with instructions I proceeded to Colorado on the evening of July 15, to be present at the meeting of the Association of American Agricultural Colleges and Experiment Stations that was held at Denver July 16 to 18, inclusive. Here I was enabled to meet and converse with various station and college entomologists, as well as other persons from different parts of the United States and Canada, and obtained much information that materially aided me in looking up the "locust conditions" over the West and Northwest during the past six weeks.

During my attendance at these meetings several excursions were made into the surrounding country. In these excursions the regions around Denver, Golden, Fort Collins, and some of the neighboring towns were visited while examining into the condition of the outbreak of "native" locusts or grasshoppers which occurred along the eastern foothills of the Rockies on the Platte River and its tributaries. Of these insects observed the following were the most abundant: *Melanoplus bivittatus*, *M. atlanis*, *M. fædus*, *M. packardi*, and *Dissosteira longipennis*. All of these had been known before as destructive in one or more parts of the United States, as will be seen by reference to Bulletin 28 (first series) of the Division of Entomology, but this particular region had never before suffered much from the attacks of locusts, save of *spretus*, which seems to be almost entirely absent from the region the present year. In fact, few specimens of it were seen anywhere over the entire area covered in my journeys during the summer.

While the injury caused by these "native" locusts has been comparatively light the present year when we remember the ravages of the Rocky Mountain locust in years gone by, sufficient has been done by them to warrant decisive action on the part of settlers in the counties of Douglas, Elbert, Bent, Jefferson, Arapahoe, Boulder, Weld, and Larimer. In these counties only, so far as could be ascertained by riding over the State and by inquiry at the office of the State board of horticulture, the secretary of which has charge of matters relating to insect

[1] Report made in accordance with letter of instruction from the Entomologist, dated July 5, 1895.

and other fruit pests, do these locusts appear to be present in abnormal numbers.

Just how long they have been on the increase, and to what cause or combination of causes this increase should be attributed at this time, was not learned. Out on the plains away from the foothills and the irrigating ditches the large species mentioned in Bulletin 28 as the "long-winged locust of the plains" (*Dissosteira longipennis*) seemed to be the characteristic form. The *Melanoplus fœdus* was also quite abundant there. Near Denver *M. fœdus*, *M. atlanis*, and *M. bivittatus* were the forms concerned in the devastating work. At Fort Collins only *M. bivittatus* seemed to be present in unusually large numbers, while farther east and at a greater distance from the mountains *M. fœdus* and *M. atlanis* became equally numerous.

In this Colorado region of locust abundance the pest may be on the decline, since at one point at least large numbers of them were destroyed by the fungous disease known as *Empusa grylli*. The good effects of this disease were especially marked in the vicinity of Brighton and the neighboring towns along the Platte River between Denver and Greeley. At other points, however, the disease was not found, and the grasshoppers seemed quite healthy and remarkably free from natural enemies of all kinds.

The hopper-dozers could be used to very good advantage over most of the region embraced in the above-mentioned locust area, and this remedy was urged as the most expeditious as well as economical means for ridding the region of the pest. The large alfalfa fields and edges of irrigating ditches seem to have been the breeding places for the various Melanopli, while the stony hillsides furnished a suitable place for the increase of *Dissosteira longipennis* and several other barren-ground species. The heavy rains and consequent rank growth of vegetation on the plains has been the direct cause for the "bunching" and more recently for the eastward and northward spreading of the long-winged species (see Bull. 28, p. 38). From recent reports received from various localities in Colorado and Nebraska it seems that this insect has appeared over a large portion of both States. It has even reached as far as the eastern boundary of Nebraska in considerable numbers.

To the northward of this region, between Cheyenne, Wyo., and Orino Junction, Wyo., where locusts of various species are usually quite abundant, and where a few forms were reported as uncommonly abundant during the summers of 1893 and 1894, this year but very few were found. A ranchman, who lives in the vicinity of Wheatland, informed me that the early opening of spring, followed by a series of cold rains during the months of May and June, had killed the young locusts off before they had a chance to do any injury. Be this true or not, there were scarcely any locusts to be found when I visited the region the last of July.

Going west from Cheyenne, a stop was made at Laramie City, from

which point a drive of 30 miles brought me to the Centennial Valley, which lies to the westward of that town, near to the headwaters of the Little Laramie River. Here *Camnula pellucida* was quite abundant on some meadows, but none of the other species were present even in moderate numbers. No immediate danger need be anticipated from *C. pellucida* at this point. It and *Melanoplus atlanis* were also moderately common in and about Laramie City.

Through inquiries made at the University of Wyoming it was learned that but few 'hoppers were reported from Wyoming points, save in the region of the Big Horn Mountains, where a species of Anabrus was very abundant and did some injury to crops and garden plants. This insect was present in force both in the Big Horn Basin and on the eastern slopes of the mountains bearing the same name. Specimens were seen by me that were taken at Lander and at Sheridan.

Locusts in rather large numbers were observed along the railroad between Wasatch and Echo, a few just before reaching Ogden, and larger numbers north of Ogden and before Brigham City was reached. The most numerous species were *M. bivittatus* and *M. atlanis*, although in some hayfields *Camnula pellucida* was present in more than ordinary force.

Upon arriving at Logan it was found that the greater part of Cache Valley was more or less overrun by locusts. At the agricultural college and experiment station some attention was being given to their destruction and study. Here nearly all of the commoner species were unusually abundant. Even *Dissosteira carolina*, our common "dusty road" grasshopper over the greater portion of the United States, was present in numbers sufficiently great to do not a little damage to cultivated crops. Some wheat fields between Mendon and Cache Junction seemed almost to swarm with them as they arose and flitted out of the way of the moving train. The other species of locusts most abundant in this particular region were *M. bivittatus*, *M. fœdus*, *M. atlanis*, *M. femur-rubrum*, *Camnula pellucida*, *Dissosteira obliterata*, and *Arphia tenebrosa*.

Judging from the large numbers of locusts of all sizes that had been and were being destroyed by the *Empusa grylli*, as well as by several species of dipterous parasites, I imagine that the plague in the Cache Valley is on the decline. Nevertheless, it would be well to be prepared to use artificial remedies for their destruction in the near future.

During my sojourn at Logan two of the field agents of the Division of Botany visited this region, from whom it was learned that locusts were nowhere abundant in the parts of Montana where they had been. Since these gentlemen are both good observers, I am fairly confident that the valleys of the Madison, Jefferson, Gallatin, etc., are pretty free from these insects.

From the Cache Valley I next went to Pocatello, Idaho, where no indications of locusts, even in ordinary numbers, were found. As near

as could be learned through inquiry, the vicinities of Shoshone, Belview, Hailey, Ketchum, Boise, etc., are quite free from locusts at this time. Not so, however, as regards the large Anabrus. Much trouble is reported to have occurred over a considerable portion of south Idaho, its droves having done much damage to crops and garden plants. No stop was made to investigate these crickets, since it was already too late in the season for such investigations.

At no point in Oregon, and not until Wallawalla in Washington had been reached and passed, did we perceive further indications of locust injuries. All along the Snake River and from there to Colfax, Pullman, Moscow, Lewiston, and Waha more or less injury had been done, and in many places was still being committed. Among the species observed in this region at different points were *M. femoratus*, *M. fœdus*, *M. atlanis*, *Camnula pellucida*, and *Dissosteira obliterata*. Each of these was present in abnormal numbers, but only, perhaps, on account of their having gathered at certain points from the surrounding pasture, where no vegetation remained.

A careful study of the situation in the area embraced by this somewhat local locust outbreak would seem to point to the fact that the present year was one of unusual drought for this part of the country. The grass on the hillsides and in pastures was consequently scanter and shorter than ordinarily, hence was sooner grazed off by stock, aided by somewhat augmented numbers of 'hoppers. The latter then moved toward cultivated grounds, where they gathered and injured both grain and fruit trees. While no one district was completely devastated by the insects, taking the region as a whole, much damage was done. In a number of places, more especially along Snake River, where there is still much cultivated ground among the adjoining hills, large numbers of fruit trees were completely defoliated, while the fruit with which they were laden was still immature. Some of these defoliated trees early in the season put out new leaves, but those that suffered the loss of foliage later and those very full of fruit were still bare at the time I was in the country. Of course such loss of leaves will injure the trees in addition to the loss of the fruit crop for the year.

The outlook for this region in the near future, to my mind, is not as encouraging as I would wish it to be.

The pest appears to be on the increase rather than on the decrease. No disease was found among the 'hoppers in any of the districts visited by me, nor had any of the persons with whom I conversed on the subject observed any such attack. True, many dipterous parasites were found attacking the locusts at all points, as were also predaceous insects, birds, and other natural enemies. These working alone, however, would hardly be sufficient to entirely check the increase of the plague should climatic conditions prove favorable for their development the coming year. Then, too, the very rough nature of the country where the locusts have bred would preclude the use of the kerosene pans or hopperdozers

in their destruction while small and before they entered the fields, either on the uplands or in the valley. Plowing and other ordinary methods employed in the destruction of their eggs could not be employed to any great extent either, on account of the very rocky nature of the ground and excessively steep hillsides where these are placed. Should the pest appear in force next spring no doubt some inexpensive and effective remedy could be found by a person on the ground, but at present I can think of none to suggest.

In closing, I wish to say that I have no apprehension of an invasion from the Rocky Mountain locust at any point in the near future. There may and undoubtedly will be local outbreaks of various "native" species of locusts in different parts of the country, both in the East and West. The only way, therefore, to protect ourselves from these is to attack them vigorously and in time.

GRASSHOPPER REPORT FOR 1896.

By Lawrence Bruner, *Temporary Field Agent.*

In accordance with my commission and instructions dated July 30, I have investigated the condition of the locust or grasshopper plague in Nebraska and adjoining States, and report as follows:

Early in June reports of grasshopper injury began to come to the University of Nebraska through correspondents living in various sections of the State along its south central portion. These reports were received by both the United States weather observer, who is located here, and by the writer. At first the reports were few and scattered, but about the time small grain began heading they became much more frequent, so numerous, in fact, that the writer felt called upon to issue a press bulletin upon the subject.

At this time—i. e., quite early in the season—it was thought by the authorities at the University of Nebraska that these locusts were simply several of our native species that had become abnormally abundant in these localities on account of the protracted drought. A little later, when specimens of the insects in question were received in response to requests sent out by the writer, it was found that a large percentage of them were the much-dreaded Rocky Mountain or migratory locust, *Melanoplus spretus*. This, of course, at once aroused the farmers of the infested region, who had already suffered the loss of two or three consecutive crops on account of the drought.

A little later other reports were received from correspondents located in the extreme western part of the State, north of the Platte River. These latter stated that the 'hoppers had hatched in "countless millions," and that they were sweeping everything clean as they went. The specimens accompanying some of these reports showed them to be the long-winged plains locust (*Dissosteira longipennis*) that a few years ago was so abnormally abundant in eastern Colorado between the headwaters of the Republican and Arkansas rivers.

Additional reports of locust abundance together with some slight injuries were also received from adjoining portions of Kansas, and during the latter part of June a few specimens of the Rocky Mountain locust began to be observed in the air during fair days when the wind was southerly. They also began leaving the southern counties of Nebraska during the last week of that month, and from that time on

till early August they could frequently be seen in the air in considerable numbers. Nearly all of these flights, so far as could be ascertained, were toward the north and northeast, the remainder being south and east, but of little consequence.

The region over which this insect hatched, while quite large, did not contain very many of them, comparatively speaking, for the injuries were restricted to isolated districts, and even here not all of the fields suffered to the same extent. The injuries were in no case complete, as only the edges of fields of small grain, principally oats, suffered from their ravages.

The presence of this insect even in these comparatively small numbers was a complete surprise to us here at the university, since not a single correspondent had mentioned a word about their having come into the country and laid eggs last fall.

After having carefully gone over much of the territory embraced in the region where this insect hatched the present year, and also of the surrounding country, I do not apprehend any great damage from it the coming year. Judging both from personal observations and the reports of others, it has so scattered and dwindled that it may not even be heard from next year. While much time has been expended by me in travel and correspondence with the object in view of locating any possible swarms of this insect since it was observed in flight, none have been found. The only conclusion, then, that I can arrive at is that they have scattered as suggested above. This also appears to be the only region where the species is present even in small numbers, since none were seen by me in Wyoming, Colorado, extreme western Kansas and Nebraska, and the western portion of the Dakotas. Inquiries sent to Montana, Utah, and Idaho also failed to elicit evidence of its presence in these States.

Several other species of locusts were found to be destructive in both Nebraska and adjoining States. Among these were the following-named forms: The lesser migratory (*Melanoplus atlanis*), the red-legged (*M. femur-rubrum*), the two-lined (*M. bivittatus*), the differential (*M. differentialis*), a short-winged form (*M. lakinus*) that for the first time to my knowledge has shown a tendency to abnormal increase, and the long-winged plains locust (*Dissosteira longipennis*).

The lesser migratory species was observed in portions of Colorado and Kansas, and is at the present time quite plentiful over much of the eastern half of Nebraska, western Iowa, some parts of South Dakota, and Minnesota. Here at Lincoln it has shown a tendency toward migration during the month of September. Every warm fair day a few of them were to be seen in the air even at considerable heights, while others were observed to voluntarily get up and fly rather long distances, as if bent on getting away from the locality. Should we suffer from locust depredations in this immediate vicinity next year, I believe it would be due to the work of *atlanis* rather than that of any other single species of locust.

In Colorado and parts of western Kansas this insect is less numerous than are either the red-legged or two-lined species, hence but little if any above normal. Just what the condition is in those portions of Michigan and adjoining States I can not say.

The red-legged locust is and has been fairly common in very nearly the same localities as the preceding. It is less liable to be harmful in the immediate future, since it does not possess the migratory habit in a sufficient degree to be of much practical aid to it in escaping unfavorable conditions.

The two-lined and differential locusts were present in destructive numbers over a considerable area in Colorado and western Kansas. The former was the chief depredator along the base of the mountains from Denver northward nearly to Cheyenne, Wyo. The latter seemed to preponderate in the Arkansas valley of eastern Colorado and western Kansas. In both of these localities the plague is apparently on the decline, if the reports obtained from citizens can be depended on. Where the *Empusa grylli* or locust fungus attacked them last year they have quite noticeably diminished in numbers, though they are still present in far too large numbers to suit those who must stand their ravages or else fight them in order to protect crops.

In Colorado Springs and the immediate vicinity the *Melanoplus lakinus*, a short-winged form, seems to be greatly on the increase, and has already passed the "danger line." Its inability to move away from harm to itself may, however, soon cause its decrease, and no damage result.

The only remaining species of locust that was found by me to be harmful this year is *Dissosteira longipennis;* and from the fact that it actually attacked a number of cultivated plants not heretofore reported as being included in its bill of fare, we may be pardoned if we are somewhat apprehensive concerning it as to the future. It actually destroyed entire fields of small grain, some corn, potatoes, and a number of garden plants in the vicinity of Lodge Pole and Sidney, where I studied it during the month of July. Although it still seems to prefer the grama and other short grasses of the plains, the fact that it has destroyed the above-named cultivated plants would indicate that it is capable of harm when opportunities for so doing are offered.

It now occupies portions of the high prairies lying between the upper Niobrara and North Platte, between the latter and the South Platte, between this and the Republican, and southward to beyond the Arkansas into northeastern New Mexico. It extends from the vicinity of the one hundred and first meridian on the east to the base of the Rocky Mountains, and occasionally drifts eastward with the winds in considerable numbers even to Lincoln, Nebr.

One very encouraging feature connected with this insect, in the vicinity of Sidney at least, was the presence in large numbers of a peculiar long-legged Tachina fly that apparently attacked and destroyed many of the locusts. So numerous was this fly that with favoring circum-

stances it must soon reduce the 'hoppers to normal. Other locust enemies in the form of parasitic and predaceous insects, insectivorous birds, reptiles, and mammals were also quite numerous both here and along the line of the Union Pacific Railroad, where I saw swarms of this locust. Just where the eggs have been laid by this insect during the present year I can not say, but that large areas have been so afflicted is quite certain.

Of one fact I also feel certain, viz, that unless tillers of the soil very soon allow themselves to be convinced that it is not only possible to prevent much of the injury caused by insect pests, but just as necessary to attempt it as it is to destroy weeds, they may be obliged to pass through other grasshopper plagues.

SOME INSECTS AFFECTING THE HOP PLANT.

By L. O. Howard.

THE HOP-PLANT BORER.

(*Hydræcia immanis* Grt.)

PREVIOUS WRITINGS.

In the annual report of the Entomological Society of Ontario for 1872, Rev. C. J. S. Bethune, on page 33, gave a detailed description of some larvæ which he found injuring the hop plant by gnawing the stems at the ground. Canadian entomologists from time to time tried to identify the insect, but it was not until a number of years afterwards that it was proved to be *Hydræcia immanis* Grote (fig. 35).

The Canadian Entomologist for 1880–1882 (pp. 93–96) contains an article by Mr. Charles Richards Dodge, entitled "The hop-vine borer," in which he gave many interesting facts derived from the returns of the census for 1879, and showed an annual loss in New York State alone from this insect of $600,000. Mr. Dodge expressed his surprise that he could find little or nothing "in the books" on the subject of the insect, and advanced the opinion that the insect was new and undescribed. He brought together in his article a number of interesting notes from correspondents relative to the habits of the species.

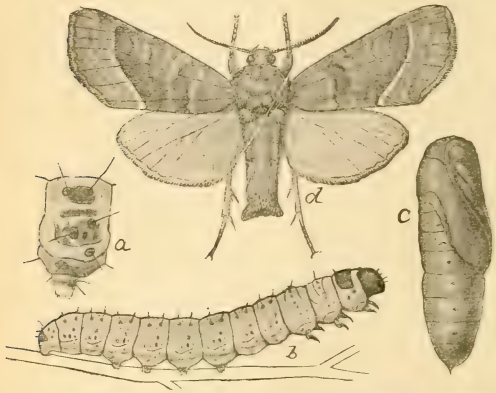

Fig. 35.—*Hydræcia immanis: a*, enlarged segment of larva; *b*, larva; *c*, pupa; *d*, adult—natural size (original).

At the annual meeting of the Entomological Society of Ontario, held at Montreal in connection with the American Association for the Advancement of Science in 1882, Prof. J. H. Comstock exhibited specimens of the adult insect which he had succeeded in rearing from the "hop-grub," and in the American Agriculturist for June, 1883 (p. 275), he published an account of the insect with determination of the species and figures of the larva, pupa, and adult. In the meantime Mr. Daniel Flint, in the Pacific Rural Press, March 18, 1882, gave an account of the insects of the Western hop fields, in which he popularly described this species and gave a short account of its habits.

In 1883 Dr. J. B. Smith, then an agent of this Division, in a report on hop insects published in Bulletin 4, first series of this Division, gave a somewhat lengthy account of the species, illustrated by three figures of the results of its work.

In 1885 Dr. J. A. Lintner, in his second annual report as State entomologist of New York, published a brief article on the species.

Finally, in his report as entomologist and botanist to the experimental farms of the Dominion of Canada for 1892, Dr. James Fletcher presented an article on the species, illustrated by an excellent figure of the adult moth, and bringing together a short account of previous writings, introducing some interesting facts from certain of his correspondents. Neither Dr. Fletcher nor Dr. Lintner was acquainted with Professor Comstock's American Agriculturist article.

GEOGRAPHICAL DISTRIBUTION.

Hydræcia immanis is a North American insect. It has not yet made its appearance in the hop-growing regions of the Pacific Coast, although in Smith's Catalogue of the Noctuidæ it is recorded from Washington. It occurs in different parts of Ontario, abundantly through New York, less so through the New England States, and south to the District of Columbia, spreading west through Wisconsin. The moth has frequently been taken at light in Illinois by Professor Wescott, at Maywood, and Mr. Worthington, at Chicago, and is recorded by Dr. Smith from Colorado. Our data do not inform us as to any wider range, but it is probable that it is a northern form, and confined, as it seems to be, to a single food-plant, it will be found only where this plant is known to grow.

NATURAL HISTORY.

From full-grown larvæ and chrysalides of the species taken in hop fields near Utica, N. Y., by Dr. Smith in the last week of July, 1883, we reared the first moth on August 8 of the same year. The specimens originally received by Mr. Bethune were taken June 27, 1868. When received the majority of them were about two-thirds grown, judging from the measurements which he publishes. Professor Comstock's experience with the insect indicates that the young larvæ can be found early in May working in the young shoots. They become full grown, he says, the latter part of July, and at this time or early in August they transform to pupæ in the ground near the roots which they have infested in their later stages. According to this author the pupa state lasts about one month, which would bring the adult insect out at the end of August or the first of September. According to Dr. Smith's account in Bulletin No. 4 of this Division, the egg, which is globular in shape and about the size of a pin-head and yellowish-green in color, is deposited by the female upon the tip of the hop vine when it begins to climb. The young larvæ are slender and greenish in color, spotted with black. They bore immediately into the vine just below the tip, and remain at

this point for some time. The vine affected in this way almost stops growing. The head turns downward, and no longer embraces the pole. Such vines are called "muffle heads" or "stag vines," and sometimes "bullheads," by the growers, and the larva inhabiting them is called the "tip worm."

When the larva is about half an inch long it leaves the tip, drops to the ground, and enters the stem at the surface of the ground, feeding to some extent upward and stopping the growth of the vine. It is now called the "collar worm." The larva changes in color at this time and becomes dirty white with a reddish tinge, and is furnished, as shown at fig. 35, with numerous black piliferous spots. It begins work by eating small holes in the side of the stem just below the surface of the ground and just below the old root, and seems to nourish itself mainly upon sap. The opening is gradually enlarged until the vine is nearly or quite severed from the parent root. Toward the end of July the larva becomes full grown and is then nearly 2 inches in length. It is stout in shape, dirty white in color, and furnished with numerous brown elevated piliferous spots, arranged as shown in the figure. The head, cervical, and anal plates are dark brown in color.

Transformation to pupa is effected in a rude cell close to the roots of the plant. According to Dr. Smith, the majority of the insects pass the winter in the pupa condition. A few adults, however, appear in the fall. Professor Comstock states that the pupa stage lasts about a month, and the moths make their appearance in the latter part of August or September. He considers it probable that these moths hibernate. Dr. Fletcher says the pupa state lasts from five to seven weeks, and that the moths are found on the wing during September and October. He further says that they pass the winter in a torpid state, probably beneath refuse and rubbish. Several specimens, which he kept alive in a breeding cage, remained constantly on the bottom and took advantage of any small object to hide beneath it. According to the observations of Dr. Lintner, the adult insect appears in the late summer, and he infers hibernation in that stage. He has collected it only between August 25 and September 6. Other collectors whom he mentions have captured the adult insect between August 15 and September 23.

Dr. Smith therefore states that hibernation is almost universally in the pupa stage, and all other authors say that hibernation in the adult state is the rule. The moth itself, although somewhat inconspicuous in general appearance, is beautifully marked when examined closely. The pattern of the wing markings is shown in fig. 35. The general color is a rosy brown, paler at the extremities of the wings. The darker central portion is shaded with dark velvety bronze and marked with two dull yellow spots. The fore wings are divided into three areas by narrow oblique transverse lines, edged outwardly with pink. The hind wings are paler in color, crossed in the middle by a slightly darker line.

The male moth (which is the sex shown in the figure) is distinguished from the female by its narrow abdomen and by a conspicuous fan-shaped brush of scales at its tip.

NATURAL ENEMIES.

In the way of natural enemies the hop-vine borer has but few. The skunk is spoken of in all articles upon this insect as a most efficient insecticide. Dr. Smith stated that in every yard in which the grubs were common and where there were convenient hiding and breeding places for skunks traces of their presence could be seen in the tunnels made by the sharp snout of the animal in its search for the fat larvæ. In the spring he noticed large numbers of young larvæ, but when in July he went to gather full-grown larvæ and pupæ he found that the skunks had preceded him everywhere and that it was only with some difficulty that he secured a few specimens. Later he requested a grower to send him some and received answer that none could be found. The census correspondence, according to Mr. Dodge, made frequent mention of the agency of this odoriferous animal. Certain growers were in the habit of leaving the skunks to carry on the warfare alone, while one grower living in Juneau County, Wis., wrote that he had seen 10 acres of hops where not a dozen hills had escaped the visits of the skunk.

Dr. Smith noticed the larva of a carabid beetle feeding upon the young larvæ at the time when they descend to the ground; but other natural enemies have not been observed, according to published account. Our notes, however, show that 2 larvæ received from Dr. Smith July 28, 1883, were dead and appeared to be parasitized, but none of the adult parasites were reared.

REMEDIES.

There is little to be said in the way of remedies that is not already known to experienced hop growers, although as a matter of fact many of the census returns of 1880 stated, according to Mr. Dodge, that no remedy is possible. The fact that the eggs hatch and the young tip worms enter the tip shoot just as the vines are beginning to climb renders it easy for experienced tiers to kill them by hand as they go through the field tying the vines to poles. An affected vine is readily recognized, and a pinch of the thumb and finger ends forever the work of the young larva.

The short period in which the worm works in the tip, however, renders it probable that many will escape this simple process before the field is all gone over and will drop to the ground and enter the base of the stem. At this stage remedial work is difficult. Mr. J. F. Clark, of Otsego County, N. Y., recommends that when the vines are well up the poles and at the first hoeing the dirt should be carefully worked away from the vines by the hoe. All dirt remaining between the vines should be carefully worked out with a sharpened stick so that all of the vines will be left bare as low down as the point where they leave

the bedroot. These become toughened by the weather and are not so attractive to the grub. Immediately after this operation a good handful of a composite, consisting of equal parts of salt, quicklime, and hen manure, mixed while slacking the lime and left standing for two weeks, should be placed about each vine root. The hops should never be hilled until the latter part of July or first of August.

Dr. Smith recommends the search for and destruction of pupæ in the spring, but, as it appears that pupal hibernation may not be normal, this proposed remedy can not be taken into account. A remedy which has generally been adopted is high hilling and fertilizing, which induces the putting out of rootlets above the main root, enabling the vines to derive nourishment through this channel where the stem has been gnawed below. Certain of the Canadian correspondents of Dr. Fletcher are in the habit of placing the remains of a kind of herring which is thrown up in large quantities on the lake shore about the roots of the hops. This, it seems, is an excellent fertilizer and prevents the attacks of the collar worm. Dr. Fletcher is of the opinion that the virtue of the fish as a preventative is due chiefly to the offensive odor of the putrefying body at the time when the young fall to the ground to attack the root.

THE HOP-VINE SNOUT-MOTH.

(*Hypena humuli* Harr.)

PREVIOUS WRITINGS.

Dr. T. W. Harris gave the name *Crambus humuli* to this insect in his Catalogue of the Insects of Massachusetts (p. 174). In his treatise on the Insects Injurious to Vegetation (Flint edition, pp. 476–478) he gave some account of the method of work of the larva, and stated that in Massachusetts there are two annual generations, the caterpillars of the first brood appearing in May and June, and transforming to moths by the end of June and early part of July, those of the second brood appearing in July and August and transforming to moths in September. He considered the insect distinct from the congeneric hop-vine moth of Europe, *Hypena rostralis*, an insect which has precisely the same habits and is also two-brooded in Germany, according to Kaltenbach. Harris's account is illustrated by a rather poor figure of the adult moth.

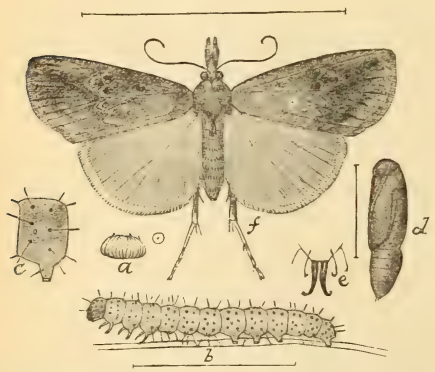

FIG. 36.—*Hypena humuli: a*, egg; *b*, larva; *c*, segment of same; *d*, pupa; *e*, cremaster of same; *f*, adult—*a*, *c*, *e*, greatly enlarged, other figures slightly enlarged (original).

In his second report on the insects of New York (1856) Dr. Asa Fitch gave a somewhat lengthy account of the species upon pages 323–327 of the special edition. The larva of Hypena he considers to be the most universal and formidable of the hop insects, making its appearance suddenly, and sometimes in a few days completely riddling and destroying the leaves of whole fields. He says the worms begin to appear on the leaves as early as the fore part of June, when the vines are rapidly climbing the poles, and secrete themselves in the denser foliage near the ground. He rather doubted the distinctness of the species from the European form, and published a rather poor figure of the adult at figure 1 of Plate I.

In his account of the insects affecting the hop vine in the annual report of the Entomological Society of Ontario for 1872, the Rev. C. J. S. Bethune, upon pages 30–31, gives a brief history of the species, illustrated by figures of the larva, pupa, and adult. The life history coincides with that given by Harris, and the author further states that the insect is frequently excessively destructive. In 1869 he observed two hopyards in the county of Peel which were almost ruined by it.

In a little pamplet entitled Hop Culture, published by the Orange Judd Company in 1891, written by the late A. S. Fuller, this insect is briefly treated upon page 5, and figures, copied from Bethune, of the larva, pupa, and moth are given.

GEOGRAPHICAL DISTRIBUTION.

This species is recorded in Smith's Catalogue from Canada, northern and central United States, south to Alabama, west to Washington, Colorado in September and October; British Columbia, May to July, September and October; Delaware in August, and Kansas in April. Specimens occur in the National Museum collection from Schenectady, N. Y.; Washington, D. C.; Iowa; St. Louis, Mo.; Bayou Sara, La., and Columbus, Tex. No other food plant than hop is known, and the insect therefore follows in this country the distribution of Humulus. In the tenth report of the State entomologist of Illinois it is reported by Mr. D. W. Coquillett as feeding upon hop in that State and as flying in August and September.

HABITS AND LIFE HISTORY.

The habits and life history of the insect as first published by Harris are substantially correct. He states that the caterpillars are false loopers, bending up the back a little when they creep for the reason that the first pair of prolegs is lacking. The body rings are rather prominent, and they are of a green color, with two longitudinal white lines down the back, a dark-green line in the middle between, and an indistinct whitish line on each side of the body. The head is green, spotted with black piliferous dots. There are similar piliferous dots arranged in two transverse rows on each segment. When disturbed,

they jerk their bodies from side to side, leaping to a considerable distance. They make no webs on the leaves, and do not suspend themselves by silken threads, like true measuring worms. When full-grown, they form a thin, imperfect silken cocoon within a folded leaf or in some crevice or sheltered spot, and transform to a brownish chrysalis. Three weeks later the moths issue. There are two broods, as stated in the first paragraph of this article. Subsequent accounts have added but little to this brief history.

According to Fitch, Harris is incorrect in his statement that the caterpillars do not suspend themselves by threads. He says that if we carefully look at an infested vine some specimens will almost always be seen hanging down from the leaves. Their attachment, however, is slight, and on the least agitation of the leaf the caterpillar lets go its hold and drops to the ground, wriggling briskly for a short time after touching the surface. When not engaged in feeding, he states, they repose upon the under surface of the leaves or leaf stalks, stretching themselves out straight and appearing more slender than at other times. He further says that some of them enter the loose dirt slightly to change to pupæ, others crawl beneath the lumps of dirt, while still others secrete themselves on or partly beneath the leaves lying upon the surface of the ground. Moreover, he says, they do not inclose themselves in cocoons, but assume the pupa state by throwing off their larval skin. He follows with a full description of the young and half-grown larvæ.

Concerning the method of pupation, regarding which Fitch and Harris thus differ so radically, Dr. Bethune states that the caterpillar descends to the ground, crawls into any crevice or place of concealment, and forms a slight silken cocoon. Mr. Fuller says that they form a loose silken cocoon among old leaves or in the cracks of the bark on the poles. Mr. Coquillett says that they enter the earth. This is a most peculiar series of contradictory statements, and from the character of the observers we can only surmise that all are correct, and that the insect may pupate in the leaves, under the bark of the poles, and at or near the surface of the earth. That it spins some sort of silken cocoon seems very certain, in spite of Fitch's statement to the contrary.

Our own observations have been reasonably complete. On May 10, 1887, Mr. Pergande found a number of the eggs of this species on the lower side of the lower leaves of the hop in all the hopyards about Richfield Springs, N. Y., as many as 6 having been found on a single leaf. The color of the egg is pale green. In shape it coincides with fig. 31, and it is longitudinally ribbed, as also shown in the figure. We have not followed out this first brood, but early in August, 1883, larvæ were found very abundantly upon a hop vine in a garden in Washington. They varied in size from less than half-grown to full-grown. Upon August 15 several had transformed to pupæ in slight webs with which they had spun together the leaves of the food plant in the breeding jar. Others transformed during the next ten days, and on August 24 the

first moths made their appearance. Between August 24 and August 29, 12 moths had issued.

The method of hibernation is not definitely stated by any of the writers, but it is reasonably certain that the moths pass the winter secreted in bark crevices and fence corners, or in old logs and stumps or other favorable localities. We have shown the insect in all stages at fig. 36. The larva, as above stated, has been carefully described by Fitch, and the pupa needs no especial description, the cremastral characters being indicated at *e*.

Natural enemies.—No natural enemies have been recorded, but from our 1883 lot of larvæ we reared, on September 5, a Tachina fly to which Mr. Coquillett has given the manuscript name of *Exorista hypenæ*.

Remedy.—An arsenical spray.

HOP MERCHANTS.

The so-called "hop merchants" are insects of which one hears a great deal in the hop fields. They are the chrysalides of two common butterflies, the larvæ of which, although feeding upon a number of different food plants, are particularly partial to hops. The species are *Polygonia interrogationis* and *Polygonia comma*. The spiny caterpillars of both species occur abundantly in the fields, feeding upon the leaves, and the chrysalides into which they transform are beautifully marked with gold or silver spots, which, under certain conditions, probably through parasitism, become suffused and give a general golden or silver tinge to the chrysalis. An interesting superstition holds among hop growers to the effect that when the golden-spotted chrysalides are plentiful the crop will be good and the price high, while if the silver-spotted ones are plentiful and the golden-spotted ones are scarce the price will be low. Although belonging to the same genus, the habits of these insects differ in certain important respects, and we shall consider them separately.

THE SEMICOLON BUTTERFLY.

(*Polygonia interrogationis* Godart.)

GEOGRAPHICAL DISTRIBUTION.

This large and handsome butterfly is widespread in the United States, occurring east of the Rocky Mountains from the borders of the Gulf of Mexico to and beyond the northern boundaries of the Alleghany fauna from Texas to central Florida, and north into the Lake Superior region. It is very abundant in the New York and Wisconsin hop-growing regions on account of the abundant supply of what is perhaps its favorite food plant. The butterfly itself is found in gardens, in open glades, and upon the roadside in the vicinity of woods. It is attracted by the sap flowing from wounded trees and by the juices of decaying fruits. It is subject to many fluctuations in numbers and while exceedingly common one year may be very rare the next.

The species is double brooded, hibernating in the butterfly condition and laying its eggs late in May or early in June. On account of this comparatively early oviposition, the caterpillars of the first brood are rarely found upon the hop, and the eggs are therefore laid upon some one of the other food plants of the insect, which mainly belong to the family Urticaciæ, and comprise, for the most part, elm, hackberry, nettle, and false nettle. From late flyers of the hibernated adults, however, a few eggs may be laid upon the hop plant, but in general this first brood of caterpillars plays no part in hop culture. The eggs laid upon the other food plants, however, hatch in from four to eleven days, the larvæ growing rapidly and passing from eleven to fourteen days in the chrysalis, and finally emerging as butterflies in July. These fly until the middle of August, laying their eggs late in July and all through August. In hop-growing regions eggs of this brood of butterflies are laid mainly upon the hop plant, and, as before stated, in certain seasons are numerous enough to badly rag the leaves, and in this way to appreciably reduce the vitality of the plant. A number of successive years, however, may occur in which the larvæ are comparatively scarce. The butterflies from this generation of caterpillars begin to appear toward the end of August and continue to emerge from chrysalids until the end of October, the chrysalis state in this brood lasting sometimes as long as twenty-six days. These butterflies hibernate.

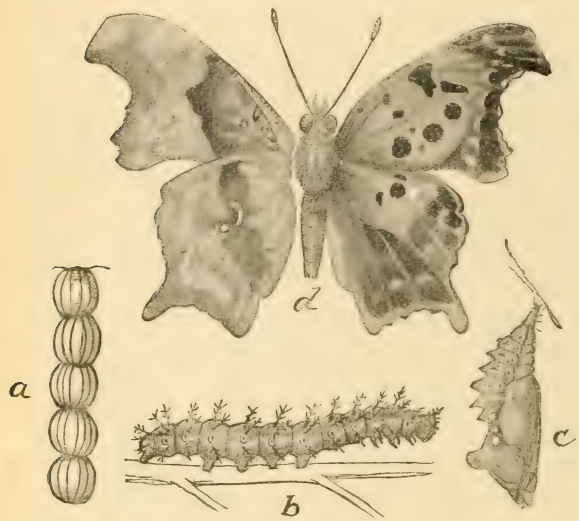

FIG. 37.—*Polygonia interrogationis: a*, egg chain; *b*, larva; *c*, chrysalis; *d*, adult—all natural size except *a* which is greatly enlarged (original).

In the South there are said to be three broods, and according to Mr. W. H. Edwards there may be four or five in Florida. The eggs, which are shown at fig. 37, are usually on the under surface of the leaves, although occasionally upon the upper, and sometimes upon the stem, the tender terminal leaves being preferred. They are laid either singly or in hanging columns of 2 to 8, 3 or 4 being most common.

The caterpillars may occasionally be more or less gregarious. While

young more than one caterpillar is usually found upon a leaf. From the very start holes are eaten quite through the leaf, and the larva at first feeds about the margin of these holes. They feed openly as a general thing, with no other concealment than the leaf itself, which is not folded, although Scudder records a single case in which he found them making nests upon hop, resembling those made by the caterpillars of *P. comma*, soon to be described.

The chrysalis is often suspended from the leaf or stem of the plant upon which the larva has been feeding, but the caterpillar, when about to pupate, also frequently crawls from its food plant and suspends itself upon some neighboring plant or often upon a stalk of grass.

DIMORPHISM.

An interesting instance of dimorphism occurs with this species. The wintering butterflies all belong to one form, which has been called *fabricii*, but which differs in both sexes and in both the upper and lower aspects of the wing from the other form. The summer brood eventually developing from the eggs laid by these hibernating butterflies is composed exclusively of the other form, which is known as *umbrosa*. The differentiation is very marked, and the relegation of each form to its distinctive brood is quite constant. The matter becomes more complicated farther south, where there are more annual generations, and here there is to a certain extent an overlapping of forms. Thus, in 1882 Mr. Edwards had bred more than twenty batches of insects, mainly from eggs of which he knew the exact parentage, and had raised over 500 butterflies. Up to 1878 all of the eggs laid by hibernating *fabricii* produced *umbrosa*. The eggs of the second brood produced 88 per cent *umbrosa;* of the third brood, 55 per cent *umbrosa*, and of the fourth brood all *fabricii*. In the following year the proportions varied only in the second and third broods, which were changed relatively to 83 per cent and 68 per cent.

NATURAL ENEMIES.

The fluctuations in the abundance of this species in hop fields and elsewhere are largely due to the fact that it is commonly subject to the attacks of parasites. Moreover, large number of the eggs are destroyed by spiders and various insects. The eggs are also infested by a minute parasite, *Telenomus graptæ* Howard, a dozen or more of which will sometimes issue from a single egg. The larvæ are stung when full grown by *Pteromalus vanessæ* Harris and *Hoplismenus morulus* Say. The smaller dark green or golden colored imagoes of the former species issue in numbers from a hole in the side of the chrysalis, and the single large somber *Hoplismenus morulus* perfectly decapitates the chrysalis in its escape.

Remedies.—Hand picking and spraying with an arsenical solution.

THE COMMA BUTTERFLY.

(*Polygonia comma* Harr.)

GEOGRAPHICAL DISTRIBUTION.

This butterfly, which is one of the commonest of our northeastern forms, belongs distinctively to the Alleghanian fauna, extending south into North Carolina and Tennessee and north into various parts of Canada, especially toward the east. It is found occasionally in small numbers as far west as Wisconsin, Iowa, and Nebraska, and has been recorded from Texas. Wisconsin is too far from its normal range to allow it to be abundant in the hop fields, but in New York it is perhaps more frequently found than the species which we have just discussed, and, in fact, it is probably more abundant in this State than elsewhere. In New England Scudder says that it is nowhere a very common insect, but in West Virginia, owing probably to local causes, it is very numerous. The insect is distinctively called by Scudder "the hop merchant," but, as we have already shown, the name is applied indiscriminately to the chrysalis of *interrogationis* as well.

FIG. 38.—*Polygonia comma: a*, egg chain; *b*, larva; *c*, chrysalis; *d*, adult—all natural size except *a* which is greatly enlarged (original).

HABITS AND NATURAL HISTORY.

In the hop-growing regions of New York the insect is double brooded, the butterflies hibernating and flying in the early spring, living on into the latter part of May and even June. The first brood of caterpillars lives, in the main, upon elm, and young elm trees recently set out are frequently injured by the loss of almost their entire foliage in the spring. Where the roots have taken hold, they recuperate from this defoliation and put out another crop of leaves, but the damage is sometimes fatal to trees which have just been transplanted. Aside from the elm, this early brood may also feed upon nettle and false nettle. The

adult butterflies developing from the first brood of larvæ begin to breed at the end of June and fly until late in August. In hop-growing regions the majority of the eggs of this set of butterflies are laid upon hop vines. The resulting caterpillars feed until well on in August, and the butterflies which are to hibernate make their appearance from the latter part of this month until the latter part of September. They enter hibernating quarters almost immediately, since they are rarely seen in October.

The eggs, as seen from the plate, are very similar in shape and size to those of the semicolon butterfly, and are laid in somewhat similar depending columns, which vary in number from 2 to 9 eggs. Frequently several of these columns will be found upon a single leaf, usually upon the under surface, but occasionally upon the stem or upon the tendrils. Although frequently a large number of eggs are thus found upon the same leaf, the caterpillars are in no sense gregarious. On hatching they almost invariably migrate to other leaves, and each one lives singly. At first it feeds without concealment on the under surface of the leaf, then it begins to draw the outer edges together by silken threads as a sort of protection, apparently, from the daylight, as it feeds mainly at night. The young larvæ are dark colored and nearly black, but grow lighter with successive molts.

DIMORPHISM.

Just as in the preceding species, a dimorphism occurs with the comma butterfly. The hibernating form has been called *harrisii* and the summer form *dryas*. The distinction between the two forms is not as marked as with the preceding species, nor is the relegation to distinct broods as marked. The fact which we have just noted may be called simply the general rule. In its southern range the species is three brooded, the first brood being composed of *dryas*, the second of both forms, and the hibernating brood of *harrisii* only.

NATURAL ENEMIES.

This species is quite as extensively parasitized as is *interrogationis*. Dr. J. B. Smith, after his experience in the hop fields in 1883, stated that not one in ten of the insects ever reaches the butterfly state. The chrysalids which he collected in the autumn were without exception infested. The parasite which caused this great destruction of chrysalids in 1883 was *Pteromalus vanessæ*. The only other hymenopterous parasite found to affect this insect is *Glypta erratica*, which Dr. Riley reared in Missouri from the chrysalis of the butterfly. Mr. Scudder also states that he reared or had sent to him a tachinid fly raised from this species, but the specimen has been lost, so that he does not know the locality or the species.

Remedies.—Same as for preceding species.

THE PLUM PLANT-LOUSE.

(*Myzus mahaleb* Fonsc.)

By Theodore Pergande.

Several species of plant-lice occur upon the plum, and one of these is so much like *Phorodon humuli*, the hop plant-louse, in certain stages of its development that without great care the observer will be led astray. Its habits are different, and it never migrates to the hop. This species is *Myzus mahaleb* Fonscolombe. It was formerly considered as a true Phorodon, and is quite generally mentioned in literature under this genus. On account of the confusion liable to arise, we may devote some little space to a consideration of this species. The generic characters separating Myzus from Phorodon are as follows:

Frontal tubercles prolonged at inner angle into a prominent, slender, porrected tooth; first antennal joint bluntly but distinctly gibbous..... *Phorodon.*
Frontal tubercles gibbous at inner angle; first antennal joint without a tooth..... *Myzus.*

In *P. humuli* the inner apical angle of the frontal tubercles is prolonged into a rather long and slender branch, reaching in the apterous females, larvæ, and pupæ, except those of the first generation, to about the apex of the first antennal joint, being somewhat shorter, though still slender, in the winged form, and having a distinct, stout, and blunt tubercle near the inner apical angle of the first antennal joint. In *M. mahaleb*, however, the inner prolongation of the frontal tubercles is rather insignificant, stout, and rounded, and the tooth of the first joint is wanting in all generations. The only generation in which both species are difficult to be separated is the first, in which the frontal tubercles in both species are scarcely indicated, whereas in the last or sexual generation the females of both may be separated without difficulty.

The synonymy of the species is as follows:

Myzus mahaleb Fonsc.

Aphis pruni-mahaleb Fonscolombe, Ann. Soc. Ent. de France, X, 1841, p. 175.
Aphis mahaleb Koch, Pflanzenläuse, 1857, p. 113.
Myzus mahaleb Passerini, Aphididæ Italicæ, 1863, p. 26.
Phorodon humuli var. *malaheb* Buckton, British Aphides, 1876, p. 168.
Phorodon humuli var. *mahaleb*, Thomas, Nox. and Benef. Ins. Ill., 1878, p. 72.
Siphonophora achyrantes Monell (?), Nox. and Benef. Ins. Ill., 1878, p. 187.

Regarding the synonomy of this species much uncertainty has previously existed. Notwithstanding that Fonscolombe and Koch have indicated its specific characters and Passerini its generic position, it is still

considered by some authors as but a variety of *Phorodon humuli*, simply, as it appears, on account of its occurrence on plum in company with *humuli* and on account of the general similarity in color and markings.

During 1886 and 1887, its life history was carefully studied by the writer, and its identity with the species described under this name by Fonscolombe, Koch, and Passerini affirmed. That considerable difficulty has been experienced in this task goes without saying.

FOOD PLANTS OF THE SPECIES COMPARED.

Notwithstanding the great superficial similarity of the two species, the life habits of both during the course of a season are quite dissimilar. Whereas *Phorodon humuli* subsists, as far as known, exclusively upon the different varieties of plum and hop and produces but one return migrating brood in fall, *mahaleb*, from the time that its migratory form leaves the plum, is never found upon the hop, but is able to accommodate itself through succeeding generations to the peculiarities of a considerable number of quite dissimilar plants, which are in no way related to each other nor to the plum or the hop. The diversity of habit of the species after leaving the plum or peach is well illustrated by the fact that its progeny will thrive equally well upon the pear, sunflower, Rumex, kohlrabi, chrysanthemum, shepherd's purse, Portulaca, and a number of other plants in the conservatory of the Department of Agriculture, among which the following ones appear to be most subject to its attacks: Rhamnus, Mallotus, Rhus, Alfredia, and a species of tobacco, on most of which plants it multiplies with wonderful rapidity. Considering the great variety of plants which it inhabits, it will not be strange if in the future it shall be found, after more careful observations, both in this country and Europe, that quite a number of described species are identical with *mahaleb*, and we believe that we are justified in referring to this species the form described by Mr. Monell under the name of *Siphonophora achyrantes* (8th Rep. Nox. and Benef. Ins. Ill., 1879, p. 187).

Koch's description of *mahaleb* is quite comprehensive, and can not be mistaken for *humuli*. If Koch had not seen and examined both species at the same time as found upon the plum, he would certainly not have expressed himself in the words he used in his description, that, notwithstanding its close resemblance to *humuli*, it differs markedly from that species in the absence of the tooth at the inner apical angle of the first antennal joint, as well as in other minor characters.

No one who has studied plant-lice carefully, or who has had occasion to study these two species simultaneously, will entertain a doubt as to the correctness of Koch's observation. The characters of the frontal tubercles and of the first antennal joint, which separate the two species, are so obvious and of such constancy through all generations, except perhaps in the first, that it would at least be hasty to consider them as varieties. There can be no doubt whatever that the two species are

in no way specifically related, and that the true position of *mahaleb* is where Passerini correctly placed it, in the genus Myzus, whereas *humuli*, on account of its frontal and antennal characters, belongs to Phorodon.

LIFE HISTORY OF MYZUS MAHALEB.

The following account is based mainly upon observations made at Washington, D. C.:

The hatching period of the eggs in this latitude ranges from about the 20th of March to the first week in April, being either accelerated or retarded according as the weather is favorable or otherwise, but always at the time when the sap commences to rise and the buds to swell. This period is the most critical in the life history of the species, as numerous individuals will perish from cold and wet if weather changes occur suddenly and frequently, for their ranks may be depleted to such an extent that perhaps not more than 5 or 10 out of 1,000 may succeed in reaching maturity.

The hatching commences generally about the 15th or 20th of March, so that in a few days, if the weather be favorable, there appear hundreds of young larvæ on all the twigs and buds. Cold showers and frost, however, during the following days reduce their numbers to such an extent that few can be found. Those which survive attain maturity about the 10th of April—about twenty days or a little more after hatching—and commence at once to deposit their larvæ, increasing in number quite rapidly as it becomes warmer and as the leaves expand. Before acquiring full growth the stem-mother casts five skins, changing but little in general appearance, except in size, in the number and length of the antennal joints, and in the length and shape of the nectaries. The antennæ of the mature stem-mother are six-jointed.

The second generation grows more rapidly than the first, so that many are full-grown before the 25th of April, when they have assumed the general characters of the species, which they retain with but slight alterations through all following generations. The antennæ are now seven-jointed and the nectaries long and slender. This generation, as a rule, is apterous, like the preceding generation, though occasionally there develop in one or the other colony one or a few winged individuals. These winged specimens are very shy and drop and fly off at the slightest jar. This early appearance of a few winged specimens is an evident provision of nature to preserve the species from destruction in case a third or genuine migratory generation should fail to reach maturity. The lice now increase quite rapidly in numbers, and station themselves along the midrib of the young leaves, causing them to twist and curl into different shapes.

The third generation grows still more rapidly, so that many of the oldest individuals are already winged by or before the 5th of May, while the great bulk reached the winged stage between the 9th and 20th of the month. In this generation, as in the preceding, a few individ-

uals remain apterous and produce a fourth generation, most of which become winged toward the end of the month or early in June. Some of the winged fourth generation deposit a few larvæ on the tree on which they were born before leaving in search of other suitable plants.

On warm days during the swarming period of the third generation the air is often filled toward evening in the neighborhood of the infested trees with the winged individuals searching for suitable plants upon which to settle.

The few remaining apterous females of the third generation have now a hard struggle to escape their enemies, which by this time have become extremely numerous, so much so that very few escape to establish colonies of the fourth generation. Still fewer escape to form the fifth. Some of both the fourth and fifth become winged. Natural enemies or a prevalent fungous disease destroy so many that the last few stragglers may be seen on the trees early in June, and this appears to be the extreme limit of the spring generations on the peach or plum, at least in the vicinity of Washington.

In the meantime, however, the migrating forms have been able, as stated before, to establish and distribute their progeny on a number of different plants over a wide area of country, often miles away from any peach or plum trees, raising immense colonies, many individuals of which become again winged from time to time, till the raids of their enemies reduce them more and more, so that from the 10th to the 20th of July hardly an individual is to be found on any of the infested plants. They apparently disappear completely, though there can be no doubt that they still exist in one form or another either above or below the surface of the ground on different kinds of plants. No trace of their whereabouts has been found so far.

After an intermission of four or five months, after leaving the peach and plum, the winged female return migrants suddenly make their appearance again on the trees, from about the first of October till toward the middle of November, so that at times all the leaves and twigs are literally covered with them and with their larvæ. All the larvæ which are now produced belong to the true sexual generation, and are composed exclusively of apterous females, which, however, differ considerably in appearance from all other apterous generations, the oldest of which reach full maturity by the end of the month or the first of November, by and after which time, for about two or three weeks, a large number of migrants appear. These are almost entirely males, which at once commence to pair with the females, after which, in about a day, the latter deposit their eggs, to the number of from 5 to 8, on buds, twigs, and trunk. The plants from which these return migrants come are in part those on which they settled in spring after deserting the plum and peach. There seems to be, however, some influence at work which prevents many from acquiring wings and forces them to remain where they were born. These last, one would

naturally suppose, would gradually succumb and die during winter, but this does not appear to be the case. Repeated examinations of certain plants from the time the last migrants appeared on the trees till some time in February the following year, both outdoors and in hot-houses, even after several severe frosts and snowstorms, showed the lice on all the plants in large numbers in every stage of development, and among them often many winged ones as lively and active as though the weather had been most agreeable to them.

It may be well to state, however, that the only season in which this observation has been made was that of 1888–89, in which the winter was a remarkably open one. The lice have not been searched for during other and more severe winters.

DESCRIPTIONS OF THE DIFFERENT STAGES.

FIRST GENERATION (STEM-MOTHER).

First stage.—Length of recently hatched larva, about 0.6 mm.; color almost black, with a slight greenish tinge; antennæ five-jointed, the fifth somewhat longer than the third; joints 1, 2, and 4 shortest and subequal in length; frontal tubercles wanting; legs very stout, nectaries about as long as thick, and apparently somewhat shorter than the second antennal joint.

Second stage.—Length, about 0.8 mm.; color darker or paler greenish-gray, with a slightly darker medio-dorsal line; head and all members darkest; the head somewhat polished, with a distinct and quite deep fovea on the vertex; antennæ still five-jointed, the third joint as long or somewhat longer than the two last together, with an indication of a division into two joints; frontal tubercles still wanting; rostrum shorter than the body; nectaries slightly longer than thick, with a constriction or annulus at extreme tip.

Third stage.—Length, about 1 mm.; color either greenish-gray, greenish, or greenish-yellow, medio-dorsal line darkest, while the lateral margin and end of body are often slightly ferruginous; the dorsum is also frequently marked with faint but darker irregular green mottlings; head darker or lighter dusky, polished, and with a paler median line; antennæ six-jointed, dusky, joint 3 palest at base; the third and sixth longest, about equal, or the sixth is slightly longest; the fourth and fifth subequal, each rather less than half the length of the sixth; eyes almost black; legs still stout, though more slender than in previous stages; femora and tibiæ somewhat dusky toward the end; tarsi blackish; body almost oval, broadest at the middle of the abdomen; nectaries at least twice as long as thick, reaching to tip of abdomen, slightly curved, and somewhat thinnest a short distance above base; apex dusky, the constriction as before.

Fourth stage.—Length, 1.4 mm.; general color, greenish-yellow, marked more or less distinctly on the head, dorsum, and lateral margin with crimson or pinkish spots; head faintly concave in front, with a slight median swelling; antennæ very similar in the proportions of their joints to those of the previous stage, though longer and more slender, greenish, with the tip of joints 3 and 4 and the two last joints blackish; eyes brown; rostrum rather short, reaching to about the median legs; legs of color of body, with about their terminal third dusky; tarsi blackish; body oval, tapering to a point posteriorly, and distinctly filled with almost fully developed pseudova; nectaries rather slender, slightly curved, almost of equal thickness, slightly stoutest at base, four to five times longer than thick, faintly dusky, darkest at tip; tail not yet present.

Fifth stage.—Length, 1.6 to 1.8 mm.; general, color pale greenish-yellow, with a more or less distinct darker green medio-dorsal line, marked along the lateral border

often with a more or less distinct pinkish shade; head still more concave in front, with a trace of frontal tubercles; antennæ blackish, the last three joints darkest, still more slender than in the previous stage, the third joint at least as long as the terminal two together; first joint much stouter and larger than the second; eyes brown; body regularly oval; prothorax distinctly separated from the mesothorax by a distinct suture, its lateral margin sinuate; legs more or less dusky, apex of tibiæ and the tarsi dusky or blackish; nectaries almost as long as the third antennal joint, almost straight, but slightly curved toward the apex and slightly thicker at base, reaching to the end of the penultimate segment; tail still rudimentary, broadly triangular, not projecting beyond the tip of the abdomen; pseudova apparently mostly fully developed.

Sixth or final stage.—Length, about 2 mm.; general color, pale greenish-yellow, usually with a darker green medio-dorsal and occasionally a more or less distinct subdorsal line; marked along the sides and often at the posterior end of the body more or less distinctly with pink or purple; frontal tubercles distinct, though rather short and stout, without the gibbosity at inner side; antennæ six-jointed, slender, about one-third the length of the whole insect; third joint longest, rather longer than the last three combined; they are almost colorless, the last two joints blackish; eyes brown; prothorax considerably narrower than the next segment, from which it is distinctly separated; all other segments confluent, with the sutures more or less completely obliterated, the surface quite distinctly reticulated; legs slender, of color of body, tip of tibiæ and tarsi blackish; nectaries long, slender, somewhat stoutest at base, slightly curved, reaching somewhat beyond end of body, and rather longer than the last two joints of the antennæ combined; tail prominent, slender, elongated conical, curved upward, about half the length of the nectaries, covered closely with minute, acute scale or tooth-like projections and provided each side with three or four rather long and slender, almost semicircularly curved, backwardly directed hairs; embryos fully developed; born soon after the last skin has been cast.

SECOND GENERATION.

Larva, recently deposited.—Length, about 0.7 mm.; color, pale yellowish-green; head slighty dusky, eyes brown; antennæ, legs, and nectaries pale dusky; antennæ six-jointed, joints 3 and 6 longest and subequal in length; frontal tubercles about as large as in the mature stem mother; nectaries stout, slightly thinnest at apex, and rather longer than the fourth antennal joint.

Female, mature form.—Length, 2.7 to 2.8 mm.; general color, yellowish-green or greenish-yellow, the darker specimens with a distinct darker green medio-dorsal line and a subdorsal row of six to seven somewhat transverse darker green spots; eyes brown, all members almost colorless, the sixth and seventh antennal joints and tarsi slightly dusky; frontal tubercles stout, with but a slight indication of gibbosity and rather shorter than the first antennal joint; antennæ seven-jointed; first joint almost twice as stout as the second, the third the longest and almost twice as long as the fifth; body elongated oval, the prothorax well separated from the rest, all other segments more or less confluent, except the last two or three; the whole surface densely reticulated; legs slender and rather long; nectaries slender, reaching beyond tip of abdomen, about as long as the third antennal joint, slightly curved and somewhat stoutest at base; tail similar to that of the stem mother.

THIRD OR MIGRATORY GENERATION.

Pupa.—Length, 1.9 to 2 mm.; general color, pale greenish-yellow, some more greenish and others more of an orange color, especially on head and thorax; antennæ, legs, and nectaries either almost colorless or of the color of the body; wingpads and tarsi dusky or blackish; frontal tubercles very stout, the gibbosity blunt, round, and somewhat more developed than in the female of the previous generation; antennæ

quite slender, seven-jointed; in some specimens they reach just a little beyond the tip of the wingpads; joint 3 slightly shorter than 7, joints 4 and 5 almost equal in length; prothorax as broad as head and much narrower than next segment, its sides almost parallel; rest of body broadly oval and closely reticulated; the thorax is often marked each side with a rather indistinct darker subdorsal line, ending at the posterior margin in quite distinct dusky or greenish spots or lines on the abdomen, which gradually increase in transverse length, being longest between the nectaries; two others beyond them connect with the lateral margin; nectaries about as long as the third antennal joint, rather stouter at base, and reaching almost to end of body.

Mature or migratory form.—Length, 2.2 to 2.4 mm.; expanse, 6.8 to 7 mm.; color, greenish-yellow or yellowish-green; the sides of the thorax generally more yellowish; head and prothorax dusky; antennæ, thoracic lobes, sternal plates, apical third or more of femora, apex of tibiæ, and three lateral abdominal spots black; the abdomen is marked anteriorly with one or two narrow, more or less obliterated or interrupted, transverse lines; a large, squarish, dusky spot, throwing out two short branches each side, just in front of nectaries, covering segments 3 to 5, and a broad band behind nectaries, connecting with their base; anal spot black; front of head conical, frontal tubercles more or less distinctly gibbous, though never prolonged and porrected as in *Ph. humuli*; antennæ slender, longer than the body, the third joint yellowish at base, slightly shorter than the seventh and sparsely tuberculated; the fourth about as long as the two following ones together; legs long and slender, especially the posterior tibiæ, which are almost as long as the whole body; wings large, their subcosta yellowish or greenish, stigma dusky, veins black; nectaries pale dusky, darkest toward the end, long and slender, almost of equal diameter, being rather slenderer a short distance above base, whence they bend inward, curving gently outward beyond the middle; tail pale dusky, elongate, conical, nearly two-thirds the length of nectaries, curved upward, furnished each side with three or four rather long, slender, backward-curved hairs; its surface covered with numerous transverse rows of minute sharp points.

The apterous females which occasionally occur in the third generation differ from those of the previous generation almost as much as the second generation does from the first. They are considerably smaller, measuring scarcely 2 mm. in length when fully mature, while the frontal tubercles are more prominent and more like those of the winged form; the antennæ, legs, and nectaries longer and more slender. This is in fact the migratory form destitute of wings.

The differences from this time on to the end of the season are so small, compared with those of the spring and fall broods, as to be almost imperceptible, notwithstanding that they may be found on quite a number of different plants, so that the species may always most readily be recognized.

RETURN MIGRANTS, OR PUPIFEROUS FEMALES.

The females of the fall brood which return again to the plum and peach are in general appearance like those of previous generations. They are, however, as a rule, somewhat larger and stouter, and all markings are more intensified. The frontal tubercles are still more distinctly gibbous, and the nectaries are quite distinctly inflated toward the end, giving them a somewhat clavate appearance. In many of the specimens may also be noticed three small black spots or lines each

side of the venter. These females, as soon as they settle on the peach or plum, give birth to true or sexual wingless females.

Male.—By the time the earliest sexual females are full grown, which requires between three and four weeks, the return migrants become again more numerous and prove to be generally true males. This migration continues, if the weather is not absolutely unfavorable, till the end of the season, toward the end of November or the commencement of December.

Description of male.—Length, 2 mm.; expanse of wings, 6.8 mm.: general appearance very similar to that of the migratory female. It is, however, smaller in size, with the sides of the abdomen quite parallel and with comparatively longer wings and antennæ, which latter reach quite a distance beyond the tip of the abdomen. General color somewhat darker, often inclining to orange, especially on the thorax and legs. The squarish, dusky spot on the abdomen is narrower than in the migrating female, and reaches often nearly to the end of the abdomen; it is frequently divided into three separate bands, and is usually connected anteriorly with the median one of the three lateral spots; anterior to this are the two usual narrow transverse bands and often additional minute spots. Genital claspers and a subventral row each side of five to six small spots, black.

Sexual female.—Length of the mature female, 2.4 to 2.6 mm.; body stout, broadest at the middle, tapering almost equally toward both ends; frontal tubercles dusky, short, stout, their inner angles bluntly gibbous; antennæ blackish, darkest toward the end, the third joint more or less pale at base, slender, scarcely reaching to base of nectaries; seven-jointed; third and seventh subequal in length, fourth somewhat shorter; posterior tibiæ distinctly stouter than the others; nectaries identical with those of the male and migratory female; tail shorter and stouter than in the previous stages and scarcely half the length of the nectaries; color quite variable, the palest being red, while a great many are of different shades of brown, greenish-brown, or dark grayish-green, often almost black; all, however, are marked with a more or less distinct, dusky, medio-dorsal spot; the color of the legs also varies from pale dusky to nearly black; tarsi black; nectaries dusky, black at tip; tail and tip of abdomen blackish.

Winter egg.—Length, 0.7 mm.; diameter, 0.3 mm.; regularly oval in shape, highly polished, light green, and more or less transparent at first, changing gradually to a jet black.

THE ROSE LEAF-BEETLE.

(*Nodonota puncticollis* Say.)

By F. H. Chittenden.

One of the commonest and widespread species of the leaf-feeding Chrysomelidæ is the little globose beetle now known as *Nodonota puncticollis* Say (fig. 39). In the initial number of the American Entomologist (Vol. I, p. 12) which appeared in September, 1868, Walsh has given what appears to be the first published notice of injuries that may be safely attributed to this insect. The species is mentioned as "*Colaspis*, n. sp.?" and is said to have been very numerous on June 19 of that year on the foliage of cultivated plum; also to be "no doubt, to a certain extent, injurious by feeding upon the leaves, and should therefore be devoted to destruction." * * *

Fig. 39—*Nodonota puncticollis*—enlarged (original).

The American Naturalist for September, 1883 (Vol. XVII, p. 978), published a second notice of damage by this beetle. The note in question is from the pen of Mr. E. A. Schwarz of this Division, and the beetle was observed June 10 of that year near Herndon, Fairfax County, Va., "doing considerable harm to pear and peach trees by gnawing at the tender terminal shoots of the twigs." The tips of the twigs thus injured dried up and died.

On page 158 of Prof. S. A. Forbes's second annual report for 1883 (1884) this species is briefly mentioned as occurring on grape and strawberry, and on page 159 it is surmised from the occurrence of the insect in such numbers on the latter plant that the species will be found to have similar habits and history to *Colaspis brunnea*, one of the so-called strawberry root-borers with which it was associated.

In his report as Entomologist of this Department for 1884 (p. 336) Dr. Riley mentioned this insect as an enemy of the willow, the imago being stated to feed upon "the very young, not yet fully developed leaves." At the June (1891) meeting of the Entomological Society of Washington (Proc. Ent. Soc. Wash., Vol. II, p. 218) the same writer called attention to injury done to roses by this species in the suburbs of Washington, D. C. The insect was first noticed that year, and the roses had been very largely blighted by its attacks, the nature of the damage having consisted in the boring or eating of the beetles into the buds and partly expanded flowers.

In the records above cited the species has always been referred to as *Colaspis tristis*. Until the year 1892, when Dr. Horn revised the Eumolpini (Trans. Amer. Ent. Soc., Vol. XIX), the above name comprised four species, all of similar distribution, but with somewhat different food habits. They may now be separated as regards known food plants as follows:

N. tristis Ol: On Lespedeza, Ceanothus, and other upland weeds (Hamilton).

N. clypealis Horn: On *Ambrosia trifida* in river bottoms.

N convexa Say: In the same situations (Hamilton).

N. puncticollis Say: On wild and cultivated roses, blackberry, raspberry, strawberry, and red clover.

Unfortunately, observations noted by the writer and others for *Colaspis tristis* include both *puncticollis* and the true *tristis*. This much is certain, however, that the species particularly attached to the Rosaceæ is *Nodonota puncticollis* Say. It is most abundant on the wild rose, which, as it appears to be the favorite food plant of the adult, is probably also that of the larva, which is undoubtedly a root-feeder like other species of Eumolpini. As no English name appears to have been bestowed upon this species, it is proposed to call it the rose leaf-beetle. Next after the rose, the petals and leaves of species of Rubus and Fragaria appear to be preferred by the beetle of this species. The writer first noticed its abundance on wild roses at Ithaca, N. Y., in 1883, on blackberry on Staten Island, New York, in 1886, and on strawberry at Washington, D. C., in 1891, the same year that Dr. Riley found it so troublesome on cultivated roses. The strawberry it injured by feeding in the axils of the newly-opened leaves; blackberries it damaged by voraciously devouring the petals of the flowers as well as the leaves. The writer has also seen the beetles feeding upon the heads of red clover.

This beetle measures a little more than an eighth of an inch. Its usual color is green, but it is sometimes blue or olivaceous and also somewhat bronzy. It is moderately shining and the legs are piceous. For its further identification the accompanying illustration (fig. 39) has been prepared. From other species of the genus it differs chiefly by being somewhat more oblong and convex. The punctures of the prothorax are substrigose and the elytra have a distinct umbonal costa.

An effort was made during the season of 1891 to rear this insect from the egg on potted plants but without success. The earlier stages and life history are unknown, but it is probable that in most essential particulars it resembles *Colaspis brunnea*.

The distribution accorded it by Dr. Horn (l. c., p. 232) is "from Pennsylvania and westward to Kansas, Dakota, and Montana, southward to North Carolina." In the writer's collection is also a series from Ithaca and Staten Island, New York, Orange, N. J., and Arizona.

A CASE OF EXCESSIVE PARASITISM.

By L. O. Howard.

June 17, 1896, the writer received from Dr. James Fletcher, of Ottawa, four little twigs of *Arbor vitæ* carrying specimens of the handsome Lecanium which Professor Cockerell has named *L. fletcheri*, in honor of the able Dominion entomologist. A few of the scales contained the exit holes of parasites, and the twigs were therefore placed in a small glass jar to save other parasites which might issue.

By June 27, ten days later, no less than 127 parasites had emerged. The scales were then counted and were found to be 80 in all. The holes in the scales were found to number 180, so that many parasites must have issued before they were received at Washington. Nor does the number of exit holes indicate definitely the whole number of parasites, since I have frequently known more than one parasite to issue from a single hole.

The results of the examination of the scales may be tabulated as follows:

Specimens.	No. of exit holes in each.	Total number exit holes.
18	1	18
24	2	48
14	3	42
7	4	28
2	5	10
3	6	18
1	7	7
1	9	9
10	0	0
Total number of specimens		80
Aggregate number of exit holes		180

Of the 10 specimens in which no exit holes were found, 5 were discovered, upon dissection, to contain dead parasites; 3 were immature, and had died from some undiscoverable cause; while with the remaining 2 the eggs had evidently developed and hatched. The total result is, then, a parasitism to the extent of 97½ per cent.

Even up to this point the case is an interesting one, and affords an instance of extreme parasitism such as is seldom found. When the parasites were mounted up and studied, however, the exceptional—in fact unique—character of the occurrence became evident. No less than 6 distinct species of primary parasites of 5 distinct genera were found among them, and not a single hyperparasite. This would have been most remarkable had it occurred in Southern California or the tropical toe of Florida, but coming from the cold climate of Ottawa it is little less than astonishing. When one reflects that there is hardly a species

of scale insect which is known throughout the whole of its geographical range (and many of them are now cosmopolitan) to have as many species of parasites as this, and that these all came from a single locality, nay, from a single hedge, and, in fact, from a single branch, how extraordinary it is! Further, they issued, not in different seasons, but all in practically the same week and from the offspring of probably a single mother Lecanium.

The list follows:

1. Coccophagus cognatus How., ♂	2
2. Coccophagus fletcheri n. sp., ♀	1
3. Aphycus pulvinariæ How., ♀	4
4. Encyrtus flavus How., ♂	4
Encyrtus flavus How., ♀	2
5. Chiloneurus albicornis How., ♀	6
6. Blastothrix longipennis How., ♂	42
Blastothrix longipennis How., ♀	66

The writer's previous knowledge of these species has been about as follows:

No. 1. Hosts.—Lecanium hesperidum, Lec. cerasifex, Lec. persicæ.

Localities.—District of Columbia; Bramley, Ontario; Lakeshore and Mapleville, Md.

No. 3. Hosts.—Pulvinaria innumerabilis, Lecanium fletcheri (former sending.)

Localities.—Davenport, Ia.; Ottawa, Canada.

No. 4. Hosts.—Lecanium hesperidum, Lec. cerasifex, Lec. sp.

Localities.—Los Angeles, Cal.; Champaign, Ill.; Wooster, Ohio.

No. 5. Hosts.—Lecanium sp., on pine; Lec. caryæ, Lec. sp., on Quercus aquatica; Kermes sp., ♂ on oak.

Localities—District of Columbia; Davenport, Iowa; Bluffton, S. C.; Kirkwood, Mo.; England (?).

No. 6. Hosts.—Lecanium robiniarum, Lec. spp. undetermined.

Localities.—District of Columbia; Agricultural College, Michigan; England.

I need only add that if collectors wish specimens of *Lecanium fletcheri* it will be well to apply to Dr. Fletcher at once, as it is reasonable to suppose that his *Arbor vitæ* hedge will be comparatively free from scales next season.

Coccophagus fletcheri n. sp.

Female.—Length, 0.8 mm.; expanse, 1.65 mm.; antennal scape slender, cylindrical, not reaching to middle ocellus; pedicel and first funicle joint subequal in length, the latter slightly wider; funicle joints 2 and 3 each slightly longer than 1, subequal in length, increasing very slightly in breadth; club long ovate, not flattened, nearly as long as whole funicle; entire flagellum with close, short, fine pile and sparse longitudinal carinæ; mesoscutum and axillæ faintly shagreened; head and scutellum smooth; eyes hairy; bristles of head and mesonotum black; color moderately bright yellow; eyes and ocelli coral red; tip of scape and all of flagellum, border of pronotum, tip of tegulæ, border of metanotum, and incomplete bands between abdominal segments, fuscous; wings hyaline, veins fuscous.

One female, Coll. U. S. Nat. Mus., from *Lecanium fletcheri*, received from Ottawa, Canada, Dr. James Fletcher.

THE WALNUT SPANWORM.

(*Boarmia plumigeraria* Hulst.)

By D. W. Coquillett.

In former times it was quite generally believed that the walnut tree was singularly free from the attacks of leaf-eating insects. So pronounced was this belief that even economic entomologists of note recommended making a strong decoction of its leaves and spraying this upon other trees and plants for the purpose of protecting them from the attacks of leaf-eating insects. While this supposed immunity from insect attack may hold true in regard to our native species, this is not the case with the imported English walnut, as events in a certain locality in California have abundantly proven during the last few years. This tree is quite extensively grown in the southern part of the State, and in proportion to the care bestowed upon it from a cultural point of view yields a larger revenue than any other nut or fruit tree grown in that region.

During the early summer of the year 1890 there appeared in very large numbers a spanworm not heretofore known to be injurious, and attacked the leaves of English walnut trees in Santa Barbara County, Cal. Nearly every tree in a grove of 20 acres was attacked by them, but they were most numerous near the center of the grove, which would seem to indicate that they had been present in former years, but not in sufficient numbers to attract attention. The trees measured about 30 feet in height, and the branches expanded about 40 feet; and quite a large number of them had been almost defoliated by the spanworms. The owner of the grove had himself planted and cared for it, but had never previously observed any spanworms upon it, and, in view of the fact that the female moths are wingless, it is quite impossible to account for the sudden appearance of the worms in such unusual numbers.

The eggs from which these spanworms hatch are of a dark grayish-drab color, with a strong brassy tinge; they are flattened oval, as if compressed between the thumb and finger; the surface is quite rough, and bears numerous minute transverse ridges; at each end are many rather shallow punctures, and the egg measures about five-sixths of a millimeter in length. They are attached to the smaller twigs by one of their flattened sides in loose, irregular patches, and are not arranged in any given order. Sometimes as many as 200 eggs are deposited in a single patch or cluster.

The eggs are deposited from January to April, and hatch out in from ten days to two weeks from the time they are deposited. As soon as hatched the young worms begin to feed upon the tender leaves, and, when disturbed, let themselves down and hang suspended in the air by silken threads, after the manner of other spanworms. They are then of a blackish color, with a row of whitish spots along each side of the body and a pair of smaller whitish spots on each side of the first three sutures of the abdominal segments. They are furnished with only five pairs of legs. When about five days old they cast the skin for the first time, repeating the operation at the expiration of another five days, and twice again at intervals of about three days apart, there being four molts or castings of the skin before the worms transform to pupæ.

One of the full-grown worms is shown enlarged in the accompanying figure (40, *a*). The color is a light pinkish gray, varied with a darker gray or purplish, or sometimes with black and yellow, but never marked with distinct lines; the piliferous spots are black or dark brown, and the spiracles are orange yellow, ringed with black and usually situated on a yellow spot. The worms become full-grown in the latter part of April or during the month of May; they then enter the earth to a depth of from 2 to 4 inches and form small cells, but do not spin cocoons. The change to the chrysalis takes place shortly after the cells are completed, and the chrysalids remain unchanged throughout the entire summer and until early in the following year, when they are changed into moths, which emerge from the ground from the first week in January to the last week in March. The male moth is winged, but the female is wingless and is so very different in appearance from the male that no one not familiar with the facts in the case would ever suspect that both belong to the same species. Both sexes are represented in the accompanying illustration (fig. 41), where *a* represents the male and *b* the female moth enlarged, the natural size being indicated by the slender lines. The species was originally described from a male specimen. The discovery that the female is wingless will necessitate removing it from the genus Boarmia and locating it near Phigalia.

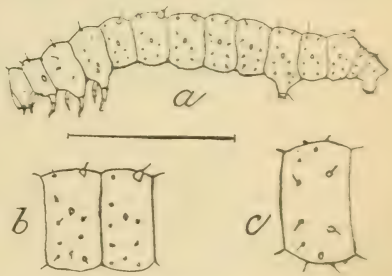

FIG. 40.—*Boarmia plumigeraria*: *a*, larva—twice natural size; *b*, fifth and sixth segments, lateral view; *c*, seventh segment, from above—more enlarged (original).

This insect has thus far been found only in California and Oregon. Besides attacking the leaves of the English walnut, the writer has found these spanworms feeding upon the leaves of the apple, prune, and oak (*Quercus agrifolia*). There is a strong probability that this insect is a native of the Pacific Coast, where it originally fed upon the

leaves of the oak above mentioned, and that it has only within recent years acquired a taste for the leaves of cultivated trees.

At least one species of Tachina fly and a small four-winged ichneumon fly belonging to the genus Apanteles prey upon these spanworms; the small, white, silken cocoon of the last-named parasite may occasionally be found attached to the trunk of an infested tree, and near it the shrunken body of the spanworm in which the larva of the parasite had lived. Quite a large number of the spanworms are also destroyed by birds, notably by the different kinds of blackbirds, which appear to be particularly fond of them.

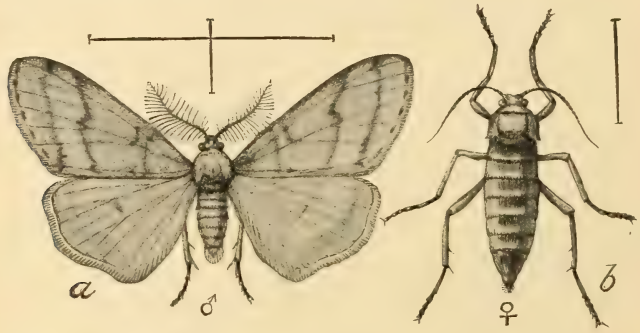

FIG. 41.—*Boarmia plumigeraria*: *a*, male moth; *b*, female—twice natural size (original).

Repeated experiments demonstrated the fact that the most efficient remedy for the destruction of these spanworms consists in spraying the infested trees with Paris green and water, at the rate of 1 pound of the poison to 200 gallons of water. This strength was found to be fatal to the worms, while the foliage was not injured by it. About 10 or 12 pounds of soap should be dissolved in each 100 gallons of this solution, in order to cause it to spread freely over the foliage. Almost any kind of soap, either soft or hard, will answer this purpose. Care should be exercised that the trees be sprayed when the worms are first hatched out. At this time a very little of the poison will prove fatal to them, whereas the nearly full-grown worms will consume a large number of the poisoned leaves before succumbing to the effects of the poison.

INSECT INJURY TO CHESTNUT AND PINE TREES IN VIRGINIA AND NEIGHBORING STATES.

By F. H. Chittenden.

Recent years have witnessed extensive destruction of the pine and spruce forests in the United States, particularly in that portion of the South east of the Blue Ridge Mountain range, and to a lesser extent of chestnut trees in the same and other regions. This injury has been very generally attributed to insects, and there is evidence that certain wood and bark boring species have largely contributed to the work of demolition. The death of the chestnuts has been laid to the account of the buprestid, *Agrilus bilineatus* Weber, while the destruction of the coniferous trees has in like manner been credited to the scolytid bark-beetle, *Dendroctonus frontalis* Zimm.

The writer has always felt a certain degree of skepticism as to whether perfectly healthy forest growth would, save in exceptional cases like the present, succumb to insect attack, and were not this view shared by others it might sound like heresy to say that the insects mentioned are perhaps not the original cause of the injury. There is more than a suspicion that a predisposing agency has been at work in causing a weakened condition of the timber of the infested region. Whatever has brought this about, there is every appearance that the insects in question have multiplied in such numbers that they were forced to attack living, if not healthy, plants or perish, as they belong to groups that do not develop in timber that has been dead long enough for the bark to become separated from the wood.

Such an enfeebled condition as suggested might be caused by bacterial or fungous disease; or it might be due to a variety of other elements, among which might be numbered too close growth, defective drainage, insufficiency or a superabundance of subterranean moisture, too great dryness, or, again, it might be produced by a dry spell suddenly following an unusually wet one, or vice versa. In the present case it seems more than probable that the soil had undergone some change that has interfered with the growth of the trees, or that a combination of unfavorable atmospheric and soil conditions has accomplished the supposed predisposing debility. The withering and dying of leaves induced by a spell of hot, dry weather following cool, moist weather, and known as sun scald, might be provocative of the debilitated condition favorable to the attacks of these borers. Possibly "pine blight," or what is known as winter desiccation, the latter occurring in mild, dry winters following autumn droughts, and particularly affecting conifers, might explain the original injury to this class of trees.

A peculiar and interesting feature of what we may call the primary insect injury is that it is due very largely to native species not previously known to be injurious; in fact, the principal pine-destroying insect, *Dendroctonus frontalis*, is even at the present time comparatively rare in collections. Another singular fact is that the invading forces disappeared as suddenly as they came, and, as is usual in such cases, we are as ignorant of the reason for the insects' disappearance as we are of the inducing cause.

As usual in so many similar instances, these cases of forest-tree injuries were not brought to the attention of entomologists until too late for thorough investigation or experiment.

December 7, 1891, Mr. W. H. Farley wrote that chestnut trees in Botetourt County, Va., were suffering from the attacks of wood-boring insects, and although no specimens were obtained it is more than probable that *Agrilus bilineatus* was concerned.

The following year Hon. Gardiner G. Hubbard sent a piece of the bark of chestnut from his suburban residence in the district of Columbia from which were reared the ensuing spring specimens of *A. bilineatus*.

During June of 1893 Mr. A. J. Wedderburn, an extensive landowner in Virginia, in the neighborhood of Washington, D. C., reported serious injuries from insects to trees, particularly chestnut and pine, on his property. An investigation as to the cause was requested, and the writer with Mr. W. H. Ashmead was detailed to visit the principal infested locality, which is situated in Fairfax County, about 17 miles from Washington, and now known as Wedderburn. The notes that follow are mainly the result of these and subsequent visits that were made in succeeding years to localities in the vicinity of Washington, where injuries to chestnut had been observed, but in spite of every effort no additional facts of value were learned and no opportunity offered for continuing the observations begun in 1893. It was in the hope that the full life economy of the principal depredator, which proved to be the buprestid beetle, *Agrilus bilineatus*, might be traced, as well as the causes that led up to the attack of this insect, that the publication of these notes has been deferred. In June, 1896, another visit was made to Wedderburn, but the Agrilus could not be found at this time, and as there is no immediate prospect that an opportunity for the further study and possible solution of the perplexing problem will be afforded it has been deemed desirable that such facts as are available be placed on record.

BORER INJURY TO CHESTNUT TREES.

The first visits to Wedderburn were made June 6 and 8, 1893. The principal damage was to chestnut (*Castanea dentata*) and scrub pine (*Pinus inops*), though very general injury to cedar and sassafras was also noticed.

The injury to chestnut was almost universal, the majority of the infested trees having been recently killed—within a year or two—few having been dead more than two or three years. The origin of the trouble may thus be traced back to about the year 1890 or 1891, or possibly a year or two earlier.

The estimated damage was placed by Mr. Wedderburn at about 75 per cent for this vicinity, and he further stated that a similar condition of affairs existed at this time in neighboring forests of the surrounding region. This was subsequently verified by the writer in conversation with other landholders of this and adjoining counties.

Two chestnut trees that had been attacked but were still living were felled, the bark stripped off, and the galleries of *Agrilus bilineatus* exposed. These galleries run mainly transversely just under the bark and are in length from 6 to 10 inches. Although none were found that completely encircled the tree, the result is practically that of girdling, through the combined work of many different individuals.

From the manner of the insect's work it can not be otherwise than exceedingly injurious, as it undoubtedly stops the flow of sap, cuts off the natural supply of plant food and moisture, and greatly weakens and eventually kills the tree. The galleries occur from the base of the trees well up toward the top.

The Agrilus was rather common on the foliage of both chestnut and oak, and a few larvæ and adults that had not yet issued were found under the bark of dead trees, but in the living trees the insects had evidently long before left the wood and had either issued or were still in the bark, as none were to be found after long search. Their characteristic galleries and exit holes, however, were noticed in all of the dead and dying chestnuts examined. From the observed fact that no other insect was present in any number in the infested trees that were still living there can be little doubt that the damage to the chestnuts is caused chiefly by *Agrilus bilineatus*, although, as stated in a previous paragraph, it is more than probable, judging from what is known of this and other similar bark-boring beetles, that the trees are first enfeebled from some other cause. A reason that may be adduced for this belief is that this buprestid is better known as an enemy of the oak, yet the trees of this genus did not show any evidence of attack, while the chestnuts were evidently all infested. Chestnut trees were also dying in the District, and it seems probable that this trouble is widespread. It is obvious that only the earlier stage of the larva is passed between the bark and the wood; indeed, it is likely that the entire life of the insect may be passed, in some instances at least, entirely within the bark.

The pupal chamber is evidently always constructed in the bark of living trees, but was also found in the wood just under the bark of small dead trees. In larger trees the last portion of the larval gallery is longitudinal and carried up to within a short distance of the outer

surface, when it gradually curves until this surface is nearly met. This last portion forms the pupal cell, and is wholly unlike the exit chamber of any other borer that the writer has seen on chestnut.

Later in the month, when the observations were made in the vicinity of Washington, the writer was in charge of the exhibit of the Division of Entomology at the Columbian Exposition. During his stay there Mr. J. S. Raymond brought in two large specimens of the work of what was undoubtedly the same insect in oak, with the report that damage of this nature was quite extensive in northern Illinois. The infested specimens were from Mr. H. E. Hamilton, Richmond, Ill., where they were attacking oaks growing thickly together on a lawn. Similarly affected trees were noticed at the same time by Mr. G. B. Sudworth, of this Department, in the neighborhood of Ann Arbor, Mich.; also by Mr. A. D. Hopkins, entomologist of the West Virginia Agricultural Experiment Station, who reported the occurrence in Insect Life (Vol. VII, p. 145), as follows:

> Quite a serious trouble, affecting different species of oak in and around Madison [Wis.], was observed, which caused the death of isolated and groups of trees of different ages. Upon examination, I found the larva of *Agrilus bilineatus* quite common in the bark of most of those that were just commencing to die. I also observed what appeared to be this same trouble at different points through Ohio, Wisconsin and Indiana; and upon my return to West Virginia I noticed a number of trees dying in the same manner; one of which I examined, September 10, and found the larva of the same Agrilus mining through the inner living bark and outer sapwood. From what I have observed up to the present date with reference to the habits of this insect, it is very evident to me that it is capable of attacking and killing healthy oak and chestnut trees, and should the conditions at any time be especially favorable for its increase I anticipate that serious trouble will result from its attack.

Of this species the same writer remarks in the Canadian Entomologist for October, 1896 (Vol. XXVIII, p. 246), that until the fall of 1895 "the dying of trees with which this insect was intimately associated was decidedly on the increase." In the vicinity of the District of Columbia, on the contrary, this condition has been constantly decreasing for at least the last three years.

THE SPECIES BRIEFLY DESCRIBED.

For the identification of the beetle and its larva the accompanying illustration (fig. 42) is presented. The beetle, shown at *a*, is elongate and subcylindrical, like others of its genus. It is black, with a more or less greenish tinge. The sides of thorax and elytra are clothed with a light golden-yellow pubescence, and the elytra are each marked with a stripe of the same color. An enlarged antenna is shown at the left (*a*), and below are the claws of the hind feet of both sexes. The larva, drawn to the same scale as the beetle, is illustrated at *c*. It is long, slender, and considerably flattened. In color it is milk white or slightly yellowish, except the mouth-parts and the peculiar anal fork, which are dark brown.

The distribution accorded this species by Dr. Horn comprises the United States from Maine to Texas and westward to the Rocky Mountains.

PARASITIC ENEMIES.

This borer undoubtedly has many insect enemies, as several genera of parasitic Hymenoptera are known to attack species of the same genus. Of the parasitic species observed in this vicinity, *Spathius simillimus* Ashm. was the most abundant, and is an undoubted parasite of *Agrilus bilineatus*, as the circumstances of its capture in the galleries of this buprestid indicate. It was exceedingly abundant at Wedderburn in 1893, and probably played an important rôle in reducing the numbers of its host. One other parasite has been reared with this species, but it has not been identified at the present writing.

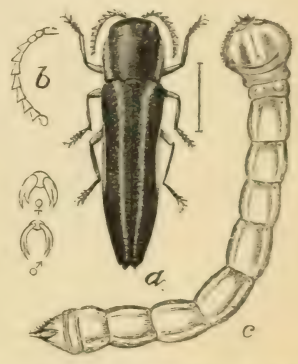

FIG. 42—*Agrilus bilineatus*: *a*, adult beetle; *b*, antenna of same; ♀, claws of posterior tarsi of female; ♂, same of male; *c*, larva—*a*, and *c*, enlarged; *b*, ♂, and ♀, more enlarged (original).

OTHER INSECTS ON CHESTNUT.

A considerable number of other insects were observed on the infested chestnuts, principally wood-boring Coleoptera. Many of these are well-known enemies of this tree, but the list includes also a number new to the chestnut. Space will not permit of the mention of more than a few of the more important or interesting species at this time. With scarce an exception they were only secondary in their attacks and it is hardly likely that more than a very small proportion are capable of initial injury to trees. The list follows:

Urographis fasciatus DeG.—This cerambycid was the most abundant borer in chestnut. It occurred in all stages under bark of recently dead trees, June 6 to 8. No imagos had issued at that time. Also reared from oak and maple.

Leptura zebra Ol.—Recorded from oak. Found in different seasons and localities in abundance on the foliage of chestnut.

Chrysobothris 6-signata Say.—Found with *Chrysobothris femorata* on the trunks of recently felled trees. Reared by the writer from beech; also affects the birch.

Alaus oculatus Linn.—Larvæ of this species were noticed under bark at the base of trees.

Dendroides canadensis Latr.—Occurred in all stages and in some abundance under the bark.

Cryptorhynchus bisignatus Say.—Taken on trunk. Previously noticed by the writer on chestnut and beech; probably lives in bark.

Cryptorhynchus obtentus Hbst.—Isolated examples of the adults,

found under the bark of chestnut, maple, and hickory, fed freely in confinement on pieces of the bark, one example living from May 24 to July 2.

The writer has not been able to ascertain the larval habits of these last two species, but it may be surmised that they live under or in the bark somewhat after the manner of *C. parochus* in butternut.

Plocamus hispidulus Lec.—Beaten from limbs, and probably lives on this tree, as it has been found by Mr. Schwarz breeding in the "outer layers of nearly dead wood" of locust.

Dryocœtes granicollis Lec.—Two colonies observed at base of trees near roots; insect in all stages, mostly pupæ and immature imagos.

Other species of Cerambycidæ, found at Wedderburn and elsewhere on chestnut, have been reported upon by the writer in the Proceedings of the Entomological Society of Washington (Vol. III, pp. 95–102), and need not be again mentioned at any length. The list includes: *Callidium æreum* Newm.; *Xylotrechus colonus* Fab., and its parasite, *Xylonomus rileyi; Neoclytus erythrocephalus* Fab., and its parasite, *Bracon eurygaster; Cyrtophorus verrucosus* Ol.; *Euderces picipes* Fab.; *Leptostylus macula* and *collaris; Liopus variegatus*, and its parasite, *Ephialtes irritator*, and predaceous enemy, *Tenebroides corticalis;* and *Eupogonius vestitus* Say.

DAMAGE TO PINES.

A year or two before the reports of insect damage to chestnut trees, came complaints of injuries to coniferous trees in Virginia, West Virginia, and District of Columbia. The first of these was from Mr. M. H. Farley, of Strom, Botetourt County, Va., who wrote October 26, 1891, of the "frightful devastation" in the pine timber of that State. The scrub pine (*Pinus inops*) was attacked first, and it was thought that unless the insect was checked it would "soon sweep the pine timber from the State." The insect, which proved to be *Dendroctonus frontalis*, was apparently working southward, having at that time reached the North Carolina line. It was also reported present in white pine (*P. strobus*).

During September, 1892, Messrs. J. R. Beaty & Co., of Crow, W. Va., reported that the same insect was apparently the cause of the destruction of pines in Raleigh County of that State, as well as in Virginia.

Other reports of damage reached the Department during the next few months, one of which, emanating from Port Republic, Va., was the occasion of a visit by Mr. E. A. Schwarz of this Division, but did not result in the finding of a single living specimen of Dendroctonus at that place, although thousands of dead beetles were in evidence of their previous abundance and injuriousness. This was in August, 1893.

One result of this trip was the discovery of a fungoid disease which manifested its presence upon the dead bodies of the beetles under the

bark. Mr. Schwarz is of the opinion that this disease was responsible for the sudden disappearance of the beetles.

Mr. S. J. Wood, of Washington, Rappahannock County, Va., stated that the dying of pine and spruce timber in that and surrounding counties was very extensive a few years since, and quite generally recognized throughout the pine forest land of the State.

Mr. Samuel K. Behrend, an employee of the Navy Department, spent considerable time in travel through the Southern States of this region while the infestation was at its height, and noticed the dying off of millions of pine trees in Virginia, injury being particularly noticeable in Buckingham County. The same conditions prevailed in North Carolina.

The primary cause of the mortality among the pine trees is enshrouded in as much mystery as in the case of the chestnuts. Whether due primarily to insects or not, certain it is that the so-called "destructive pine bark-beetle" (*Dendroctonus frontalis*) did great damage to the pine and spruce forests of this part of the South.

FIG. 43.—*Dendroctonus frontalis*: *a*, dorsal view of beetle; *b*, lateral view—enlarged about 6 times; *c*, antenna—greatly enlarged (original).

A great many dead pine trees in this vicinity were stripped of their bark, and the galleries of this species, together with the dead beetles, were found in all. A noticeable feature of the insect work on pine was the almost entire absence of the galleries of other common scolytids, such as *Tomicus cælatus*. In one spruce, however, *T. cacographus* was as abundant and apparently as injurious as Dendroctonus.

It will be unnecessary to dwell at length upon the subject of the devastation of pine and spruce forests, since, as previously stated, injuries were reported too late for investigation, and the principal ascertained facts in the matter have already been given to the public by Mr. Hopkins in the columns of Insect Life and elsewhere.[1]

The accompanying illustration of this species (fig. 43) will enable its recognition. It resembles the species of its genus in color, ranging from reddish to dark brown, but it may be readily distinguished from the other species by its much smaller size, which is one-eighth of an inch or slightly longer. An enlarged antenna (*c*), which is of a form characteristic of *frontalis*, will further facilitate its identification.

The following is the credited distribution of the species: "Carolina" (Zimmermann); "Lake Superior to Georgia" (Le Conte); "California, Arizona, Maryland" (Dietz). To this must be added the District of Columbia, Virginia, and West Virginia.

[1]Since the above was in type Mr. Hopkins has informed the writer that he now has in MSS. a full report on this topic which will soon be given to the public.

OTHER BORERS AFFECTING CONIFERS.

Owing to the absence of *Dendroctonus frontalis* at the time its investigation was attempted, little time was devoted to the boring species affecting coniferous trees. The following, however, are worthy of mention:

Leptostylus commixtus Hald.—Under this name a cerambycid has been included in Fitch's list of pine insects of New York State, on the strength of the occurrence of the beetle on pine leaves. What the writer takes to be the same species was reared at this Department from pieces of *Pinus inops* taken at Wedderburn, Va.

Graphisurus pusillus Kby.—Taken by Mr. Ashmead under bark of *Pinus inops* in an oval, cell-like depression prepared by the larva before pupating. Wedderburn, June, 1893. A rare species.

Acanthocinus nodosus Fab.—This large, showy species has been recorded to occur "under the bark of pine from June to September," in the neighborhood of Philadelphia (Proc. Ent. Soc. Phila., Vol. I, p. 97), and is ordinarily of rare occurrence. It was fairly abundant in the streets of Washington during the summers of 1894 and 1895. At one time a half dozen individuals were noticed under a single electric light, where they were being trodden upon by pedestrians. Without doubt this unusual abundance was due to the many dead trees killed by *Dendroctonus frontalis* in the vicinity.

PROBABILITY OF FUTURE DESTRUCTION OF FOREST AND SHADE TREES.

The severe windstorms that have swept over the South Atlantic States during the past year, particularly that of September 29, which was the severest ever known in this region and caused very extensive destruction of forest and shade trees, will doubtless result in still greater destruction to trees through the opportunities that the dead, dying, or injured trees afford for the propagation of injurious insects. It should be borne in mind that wood- and bark-boring insects generally prefer timber that has been recently killed, and that when this is not available they will attack injured, weakened, or even healthy growth.

PREVENTIVE AND REMEDIAL MEASURES CONSIDERED.

Such owners of forest land as have sufficient financial interests at stake will do well to clear up the dead, and trim the injured, trees. For the protection of chestnuts all dead oaks should also be cleared away and burned, and the same is true in the case of pines and other conifers. Much can be accomplished by simply removing the bark of the dead timber. The injurious species require as a rule a year for development. The first warm days of April and May will see the first numbers of the invading host upon the dead and injured trees. The succeeding month these will give place to other species, and by the end of July the most of these will have laid their eggs in cracks and crevices in and under the bark and have disappeared.

Unfortunately, in too many cases the storm-killed and injured trees will be carelessly permitted to remain as a nidus for borers, and when this wood becomes too dry and the bark too loose for the insects those that have bred in them will emerge and migrate to neighboring trees.

Before the following spring the progeny of these insects will have so loosened the bark that it may easily be removed and burned, thus destroying millions of the insects before they have an opportunity to issue and lay their eggs for the destruction of valuable trees.

In Europe in similar cases it is customary for foresters to girdle a few trees here and there and leave them standing as traps for such beetles as may not have been destroyed with their host trees. These trees in turn are decorticated the following year and others treated in like manner should appearances indicate the advisability of this course.

Some instances were noticed of chestnuts infested in dooryards and of a giant spruce near a public building. For the protection of valuable shade trees against borer attacks other more direct measures may be employed. A light coating of raupenleim and dendrolene to the trunks and lower branches would answer the purpose of preventing the deposition of eggs at this point, which is the favorite place of attack, while a heavier application would prevent the egress of the insects from the bark should the trees already be infested. A wash of lime to which a small quantity of Paris green and a sufficient amount of glue to render it adhesive has been added would also serve a good purpose.

Whatever is used should be applied just before the first warm spell of spring. At the very outset of an attack a very thin application of kerosene, kerosene emulsion, or creosote by lightly brushing or spraying it over the infested parts would kill the beetles with which it came in contact.

GENERAL NOTES.

A LEAF-MINER OF TOBACCO.[1]

We have been in correspondence with Mr. Gerald McCarthy, of the North Carolina station, in regard to a leaf-miner in the tobacco fields of that State which may be a somewhat serious enemy to this important crop. From specimens of the larvæ received from Mr. McCarthy we were enabled to rear the moth, which has been determined for us by Miss Murtfeldt as *Gelechia piscipellis* Zell. This determination reveals, what we had from the first suspected, that the occurrence of the leaf miner in tobacco was simply an instance of change of habit, more or less accidental, and perhaps not permanent. We do not understand that the damage is widespread, but, on the contrary, that it is restricted to a single locality. Just as the plowing up of rank-growing sod-land and planting it to corn frequently results in a serious attack upon the corn by root webworms, billbugs, and other insects, and just as the plowing up of a field overrun by pigweed has resulted in an attack upon the ensuing crop of sugar beets by the sugar-beet webworm, so the planting to tobacco of a field in which the horse nettle had been abundant would be quite likely to result in the transference of the attenions of the horse-nettle leaf-miners to the leaves of tobacco. Such cases are not apt to recur except under exactly similar conditions.

A GALL-MAKING COCCID IN AMERICA.

In Science for September 4, 1896 (Vol. IV, No. 88, pp. 299–300), Mr. T. D. A. Cockerell describes *Olliffiella* (n. gen.) *cristicola* n. sp. from specimens producing galls on *Quercus wrightii*, at Pinos Altos, N. Mex., collected July 8, 1896. The genus belongs to the Idiococcinæ, a group of sixteen known species, all confined to Australia, except one in the Sandwich Islands, one in Japan, and the present species.

The publication of this note reminds us that specimens of this same insect were sent to the Department of Agriculture as long ago as May 18, 1882, and that a figure was prepared of the gall by the late Dr. George Marx, at the instance of Dr. Riley. The figure has never been published, and is printed herewith (fig. 44). The notes made by Mr. Pergande on its receipt were as follows:

Received May 18, 1882, from H. K. Morrison, Fort Grant, Ariz., some galls on leaves of oak, which are produced by a brachyscelid coccid. This is the first species

[1] For bibliographical purposes it should be stated that all unsigned notes may be credited to L. O. Howard.

belonging to this group discovered in this country, all other known species belonging to the Australian fauna. The galls are situated on the lower side of the leaf, with a nearly closed slit on the upper side. The mouth of the slit, which is parallel with the midrib, is beset with a pale grayish pubescence. The gall itself is quite large, somewhat conical, laterally compressed, leaning over to one side, and ending in a slightly curved point, the whole resembling a broad, flat tooth. They are green on one side and crimson or purplish on the other, and closely covered by a short grayish pubesence which can easily be rubbed off. Each of these galls contains at this date a single specimen, which rests in the lower or pointed end of the gall. They have cast at least one skin and some evidently two. The insect is orange, broad oval, somewhat more pointed posteriorly, and with a fringe of short stiff hairs around the whole margin. The antennæ are six-jointed, the third being the longest. Eyes small and brown; proboscis stout, reaching between middle coxæ; legs stout and rather short.

FIG. 44.—Gall of *Ollifiella cristata* on *Quercus wrightii* (original).

Received June 12, 1882, another lot of these galls, which are now almost woody and quite hard. Most of them contain the insect, although others are empty, and some are inhabited by a lepidopterous larva, which preys upon the coccid. This coccid is a most remarkable insect. Its upper or dorsal surface is quite flat and fits closely to the walls of the gall, and around the whole margin is a narrow elevated ridge. The color of the dorsum is dark purplish brown and is slightly covered with a delicate pruinose substance. The lower or ventral side fills entirely the lower end of the gall. It is orange and also somewhat covered with a mealy excretion. The legs are free and movable. No eggs or larvæ were found. The lepidopteron is purplish, the head brick red, cervical shield somewhat paler anteriorly, with a broad black posterior margin. The body is marked each side with a somewhat irregular row of minute whitish spots and similar spots across the middle of the segments. The venter is pale dirty grayish yellow. Length of the largest about 7 mm.

Received May 25, 1883, some of these galls on *Q. emoryi* from Mr. Morrison, Fort Huachuca, Ariz.

DAMAGE BY THE WHITE PINE BUTTERFLY.

At the meeting of the Entomological Society of Washington, held March 18, 1896, Dr. James Fletcher, the Dominion entomologist of Canada, referred to an outbreak of the white pine butterfly (*Neophasia menapia*) in the elevated arid plateau which forms the interior of British Columbia. The larvæ of this insect, according to Dr. Fletcher, in this locality feed entirely upon the leaves of the yellow or bull pine (*Pinus ponderosa*), while at Vancouver Island, where this pine does not occur,

the larvæ feed on the foliage of the Douglas spruce and do much harm. In both cases where the insect was observed in large numbers the pupæ were found to be parasitized by an ichneumonid, *Theronia fulvescens*. The descent of the full-grown larvæ from trees 100 feet high by a silken thread was described.

August 22, specimens of this insect were received at this office from Mr. H. D. Langille, of Mount Hood, Oreg., with a letter dated August 12, which stated that the butterfly appeared that day at Cloud Cap Inn, at the snow line on Mount Hood, in immense numbers. Two years ago the insect came about the mountains in large numbers, seeming to hover about the evergreen trees mostly, and the next year whole acres of the nut pine (*Pinus monticola*) began to die, presumably on account of the work of the larvæ of this butterfly.

A week later specimens of the same insect were received from Mrs. W. J. Hess, of Goldendale, Wash., with the statement that it made its appearance during 1895 in the pine timber on the mountains near Goldendale in great numbers, in some places falling into the small streams and damming them. Some hogs pasturing in the timber died, and, upon examination, their stomachs were found to be packed with the "moths." It was noticed that year that the pine trees where the "moths" were bore no cones, while a few trees on the prairie had them as usual. The trees this year (1896), according to Mrs. Hess, were infested with a small green worm, undoubtedly the larvæ of this butterfly. For about a month in midsummer the butterflies were noticed on the prairie flying southward high in the air.

RECENT DAMAGE BY THE STRAWBERRY WEEVIL.

During May of the past year, too late as usual for remedial experimentation, complaints were received of injuries by the strawberry weevil (*Anthonomus signatus* Say) from Maryland and Virginia.

May 2, Mr. G. W. Donaldson, who has kindly kept me informed in previous years of the invasions of this destructive little beetle in his neighborhood, formerly called Dixie Landing, and now known by the somewhat more euphonious title of Cherry Dale, reported the insect in injurious abundance on his farm and on those of his neighbors who grow the "Jessie" and other staminate varieties of strawberry. Some of these farmers have several acres in strawberries and depend chiefly upon this crop for a livelihood.

May 9, specimens of strawberry buds showing injury by this species were received from Mr. Richard Mason, Marshall, Va., with the report that nearly his entire crop had been destroyed the past two springs. In 1895 he sprayed with a solution of whale-oil soap with no effect, and the past season with a solution of sulphate of copper and lime, also with kerosene emulsion, so he writes, but without any apparent effect.

In the latter days of May Mr. James S. Robinson, horticulturist of the Maryland Experiment Station, called at this office for advice

in regard to the treatment of this insect, which he reported to be almost universally destructive throughout the berry-growing region of the State of Maryland. In reply to inquiry he stated that at least fifty complaints concerning its injuries were received at the station. He estimated the damage to his own crop at about $500 or $600 and to the fruit-growing district in the immediate vicinity of Baltimore at about $20,000.

During this same month we received specimens of the insect from Mr. M. V. Slingerland, of Ithaca, N. Y., who also transmitted a complaint of injury that was undoubtedly due to the same species from Mr. C. W. Coons, Wadalin, Dutchess County, N. Y.—[F. H. CHITTENDEN.

NOTE ON THE SCOLYTID, XYLEBORUS TACHYGRAPHUS ZIMM.

One of the rarest scolytid beetles in collections is *Xyleborus tachygraphus* Zimm., and until its discovery a few years since infesting the tulip tree (*Liriodendron tulipifera*) nothing was known of its habits. In volume II of the Proceedings of the Entomological Society of Washington (pp. 62–64) Mr. E. A. Schwarz, of this Division, gave some interesting facts concerning this species and its food tree.

A year or two following Mr. Schwarz's observations the writer had occasion to observe this insect at work in other trees, there being evidence to show not only that it is capable of considerable injury to young forest growth, but that in previous years it had been sufficiently abundant to have caused the death of many trees in a tract of woodland in the vicinity of Rosslyn, Va., and in the same neighborhood in which the Liriodendron colony was found.

May 28, females were discovered beginning their galleries in the green and still living portion of a stump of box-elder (*Negundo negundo*). On the same tree similarly engaged was found *Monarthrum mali*, an account of which the writer has already given (l. c., p. 392).

June 11 of the following year another colony was discovered, occupied as before, on two saplings of red-bud (*Cercis canadensis*), both plants to all appearance in perfectly healthy condition. The entrance holes of the scolytid's galleries were a few inches above the ground and extended about a foot up the trunk. They were very closely crowded together, in one sapling no less than 16 holes being counted on one side in a surface of 3½ square inches, 9 of these occurring in a space only an inch square. On the opposite side of the trunk only two galleries had been started. Subsequently this species was found dead in its galleries, at the bases of three other young trees, likewise dead, viz, maple (*Acer* sp.), beech (*Fagus latifolia*=*ferruginea*), and sumac (*Rhus typhina*). In the maple the longitudinal galleries of the beetle ran parallel to each other and were constructed so closely together that the trunk broke off at the point of attack under slight pressure. In the beech and sumac the galleries were similarly crowded. In all findings save the last the species was represented only by one sex, the female.

Mr. Schwarz has remarked that the galleries of this species, which he describes and figures, are indistinguishable from those of our common *X. dispar*, which occurred in the same shoots. The galleries that I have seen in other woods differ considerably, but as the general design is under normal conditions somewhat similar it will be unnecessary to describe them here.—[F. H. CHITTENDEN.

THE HARLEQUIN CABBAGE BUG ON ASPARAGUS.

A striking instance of how a plant never before known as furnishing sustenance for a particular species of insect may be attacked by this insect when its appropriate and favored food supply becomes exhausted was recently observed in the case of the harlequin cabbage bug, *Murgantia histrionica* Hahn.

September 28, 1896, an asparagus bed at Marshall Hall, Md., was found to be full of these bugs. Hundreds of specimens, naturally mostly mature at this time, but including a small proportion in the preparatory stages, were seen gathered in large groups on every main stem of the plants, and so thickly grouped in places that they could easily be seen for 20 yards or more. Thus huddled together, each individual with its haustellum sunk into the succulent stem, they looked like gigantic black and yellow plant-lice.

The cause of this unusual visitation was at once apparent. Three or four large beds of cabbage, all completely ruined by these insects had been observed in this same garden on previous occasions, but the damaged plants had been removed and such bugs as had escaped had found their way to the asparagus bed, where they had seemingly made themselves quite at home. It was noticeable that the asparagus was preferred to all other plants. Only one other crop had attracted them, and this of little importance, the sunflowers, grown for indoor decoration. Beans, beets, and grapes had entirely escaped injury.

In July of a previous year the writer noticed large numbers of this species in different stages feeding on the common ragweed, *Ambrosia trifida*. About ten days later all had disappeared. No crucifer on which they might have bred was present in this neighborhood except the shepherd's purse (*Capsella bursapastoris*), a few stunted, withered plants being found among the ragweeds. They were competely defoliated, the leaves having withered, dried, and dropped off, and it is therefore apparent that the harlequin bugs had originally fed upon this plant until they had completely exhausted its juices and had then been obliged to change their food in order to complete their transformations. The adults found at this time were all newly bred individuals.

The principal damage wrought by this insect, as is well known, is to plants of the botanical family Cruciferæ, and especially to cabbage, radishes, turnips, and kale. As another instance of unusual injury by this species may be mentioned the statement of Dr. J. A. Lintner in his first New York report (p. 265). He relates on the authority of a

correspondent in Virginia that at one time after exhausting a cabbage crop these bugs attacked bunches of late grapes and shoots of late corn, gathering in numbers near the silk.—[F. H. CHITTENDEN.

MEAL-WORMS IN SODA ASH.

During October we received from Dr. John B. Porter, consulting chemist, of Glendale, Ohio, specimens of living larvæ of the meal-worm, *Tenebrio obscurus*, in a box of soda ash. Our correspondent wrote that they were found in a carload of this chemical, the crude sodium carbonate, from Syracuse, N. Y. They were noticed within 6 or 8 inches of the bottom and most numerous nearer the bottom, and especially at the corners and edges. The men who handle this material make positive statement that they frequently find cars containing immense numbers of them, and that often they penetrate nearly 2 feet into the mass. They also state that these larvæ are only found in October, November, and December, and further, that once they were found living in large numbers in a bin which had been full of soda ash and tightly closed for eight months. The car from which our specimens came contained thousands of living and some few dead larvæ. The only plausible explanation of the presence of the meal-worms in the soda ash is that the cars had previously been used in shipping quantities of meal, flour, grain, or similar material in which the insects had been breeding. These larvæ attain approximate growth toward the beginning of the autumn, which will explain their having been found only from October to December. It would be impossible for insects to feed on soda ash, and the wonder is that the Tenebrio larvæ are able to live at all in so caustic a substance.

AUSTRALIAN AND NEW ZEALAND COCCIDÆ.

In a most interesting letter recently received from Mr. W. M. Maskell, the New Zealand authority on scale insects, he gives us several interesting bits of information, among others, that an entirely new enemy to the peach has appeared in New South Wales. He describes it as *Aonidia fusca*, and states that in Sydney they are taking most drastic measures to get rid of the insect, destroying the trees as far as possible. The San Jose scale (*Aspidiotus perniciosus*) has recently made its appearance in Victoria. Hitherto it has been known only in New South Wales. *Dactylopius adonidum*, the common mealy bug of Europe, has, in the last six months, broken out in an alarming way in the Hutt Valley, near Wellington, New Zealand. During the summer and autumn of 1894 it appeared in myriads on vines in greenhouses and on gooseberries out of doors, much to the amazement of market gardeners. Mr. Maskell has found another Icerya from Australia which has no ovisac.

Referring to our note in Insect Life (Vol. V, p. 282) in which we mention on the authority of Mr. Alex. Craw the introduction of *Ctenochiton perforatus* and *Dactylopius iceryoides* into California, he states that he

has recently received from Mr. Ehrhorn specimens of the insects thus named, and finds that the first is not a Ctenochiton at all, but probably a dactylopid, while the second is not *D. iceryoides*, but *D. aurilanatus* of Maskell. The bright golden color of the latter insect and its food plant (Araucaria) ought to have been sufficient guides to correctness. The species, although first reported from New Zealand, is, according to Mr. Maskell, probably Australian, and he thinks that Queensland was probably its original habitat.

TWO APPLE INSECTS LIABLE TO IMPORTATION.

Among the insects which American fruit growers will have to guard against with reference to their possible importation into this country are *Cacœcia responsana* and *C. excessana*, the former an Australian, and the latter a New Zealand species. Both of these insects exhibit a decided preference for the apple, and the former is supposed to be almost as great a pest as the codling moth, penetrating the rind of the fruit and disfiguring it for dessert, although not seriously injuring it for culinary purposes. The latter is a leaf roller, but also damages young fruit in a rather serious way.

A NEW DIRECT BENEFIT FROM INSECTS.

When Kirby and Spence wrote their chapter on "Direct benefits derived from insects" and recorded the use of insects for food, the use of honey from bees for the same purpose, the use in medicine and the arts and manufactures of blister beetles, insect galls, Coccidæ furnishing lac, wax insects, and the silkworm, the time had hardly arrived for the extensive collection of ants for the manufacture of formic acid or of their pupæ as food for song birds, and we feel sure that they could hardly have anticipated an industry which has recently sprung up both in France and Pennsylvania, and which consists of the farming of spiders for the purpose of stocking wine cellars, and thus securing an almost immediate coating of cobwebs to new wine bottles, giving them the appearance of great age. This industry is carried on in a little French village in the Department of Loire, and by an imported Frenchman named Grantaire on the Lancaster Pike, 4 miles from Philadelphia. This Frenchman raises *Epeira vulgaris* and *Nephila plumipes* in large quantities and sells them to wine merchants at the rate of $10 per hundred.

ADDITIONAL POPULAR NAMES FOR CORYDALIS CORNUTA.

On page 122 of Volume II, Insect Life, we gave a short list of Rhode Island popular names for this insect, to which we now add the following list, taken from Forest and Stream for September 25, 1884.

Common names of Hellgramite.

(*Corydalis cornuta* Linn.)

Locality.	Name.	Locality.	Name.
Columbia Co., Ga.	Shellhead.	Monroe Co., N. Y.	Hell devil.
Water Gap, Pa.	Helwanger.	Virginia	Flip-flap, stone devil.
	Boger or Bogart.	Western New York.	Alligator.
	Algamite.	Perkiomen, Pa.	Crawler.
Southern Indiana.	Go-devil.	Carlisle, Pa.	Go Jack.
North Vernon, Ohio.	Snake feeder.	Wyalusing, Pa.	Devil catcher.
Litchfield, Conn.	Bloomer.	Hanover, Pa.	Snake doctor.
Janesville, Wis.	Crawler.	Lafayette, Pa.	Stone climber.
Fulton, N. Y.	The andy.	Flat Rock, Pa.	Clipper bug.
	Black crab.	Tulpehocken, Pa.	Kiltamite; klugmite.
	White crab.	Fox River, Wis.	Dam worm.
	Flying crab.	Schoharie, N. Y.	Dragon.
Schenectady, N. Y.	Black worm; flying worm.	Hazleton, Pa.	Devil.
Towanda, Pa.	Conniption bug.	Portland, Pa.	Bogart.
Honesdale, Pa.	Clipper.	Raleigh, N. C.	Red crab.
Milford, Pa.	Stone crab; sand crab.		Yellow crab.
Lambertsville, N. J.	Water grampus.		Hell driver.
Tumble, N. J.	Goggle goy.	Lackawaxen, Pa.	Flying clipper.
Interior, N. J.	Crock.	In many places	Hellgramite; Dobson.

NOTES FROM CORRESPONDENCE.

Eastern insects reported in British Columbia.—In the course of the very numerous "Notes from Correspondents" printed in the Fourth Report of the department of agriculture of the Province of British Columbia for 1894 frequent mention is made of the plum curculio and pear-tree psylla. Inasmuch as neither of these insects has been known to occur on the Pacific Slope, we wrote to Mr. R. M. Palmer, inspector of fruit pests of the Province, who has replied that the common pear-leaf slug is often called "pear-tree psylla" out there, and that he has never seen specimens of the plum curculio in that part of the country.

A wasp attacking codling moth larvæ.—A wasp, *Sphecius nevadensis*, closely related to the common species which in the East attacks cicadas is reported by Mr. N. W. Motheral, of Hanford, Cal., to be attacking codling moth larvæ in pears. He has not observed the wasps on apples, but the pear trees all over the country where this fruit is attacked by the codling moth have swarms of the wasps inspecting each tree. Mr. Motheral describes the wasp as pulling the larvæ out of the pears with its "fore foot." This record is new and interesting.

Cells of a leaf-cutter bee in a curious place.—A correspondent in Texas sends to the Division the larval cells of a species of Megachile, found by his wife in a disused bed between the sheet and the quilt. The species can not be determined from the material sent, but an attempt will be made to rear the adult.

Birds eating leaf-miners.—Mr. T. D. A. Cockerell writes us that he has seen a red-winged starling (*Agelæus phœniceus*) busily engaged in eating the larvæ of the cottonwood leaf miner (a sawfly). He writes that the birds are quite expert at getting the larvæ out of the leaves.

A migration of Colias cæsonia.—Instances of migratory swarms of butterflies of the subfamily Pierinæ have frequently been observed, but none have been recorded so far as we know, of *Colias cæsonia*. May 26 we received a number of specimens of this species from Dr. J. M. Shaffer, of Keokuk, Iowa, who writes under date of May 22 as follows:

"Yesterday great numbers of these butterflies passed from south to north over this place. They came up the streets and over the houses and tree tops. Very few alighted. I followed them to our park, a mile and a half, and everywhere they were moving north, hundreds of them. In a field of red clover and on the pansies and other flowers of the park I captured a dozen or so of them. * * * After 1 p. m. I went to the United States Government canal lock, just below my house, and 100 feet down the hill, and found that the butterflies came across the Mississippi. I observed them also on the bridge, and they came from Illinois, from how far east I have no means of knowing. They are very numerous to-day."

Boll worm damage to strawberry plants.—Mr. R. T. Smith, of Utica, Mo., writes us that *Heliothis armiger* has been discovered in his locality this fall damaging strawberry plants by eating the crown and destroying the runners.

Injury to apples by the ash-gray pinion.—Mr. Harry S. Burnett, of Kendall, Orleans County, N. Y., writes under date of June 7, transmitting specimens of the larva of *Lithophane antennata=Xylina cinerea*, with the statement that it is doing immense damage to apples in neighboring sections. It is found in every orchard, whether the orchard has been sprayed or not. Spraying at the right time will probably prevent this damage. It should not be sprayed until after the leaves are well grown.

Scolytid beetles boring into wine casks.—Two cases of this rather rare injury have been reported to this office within a few days of each other. September 9 Mr. Holmes Erwin sent us from Pomona, Fla., specimens of *Xyleborus pubescens*, which he stated were doing much injury to wine casks in his cellar by boring through the staves and causing leakage. On September 12 Mr. George T. Hart sent from Nickajack, Ga., specimens of *Monarthrum mali* and *M. fasciatum*, which were damaging his wine casks in the same way. This injury is one of the results of the February freeze, which occasioned such widespread disaster last winter all over the South. This freeze greatly increased the food supply of these and allied Scolytidæ, which as a consequence have multiplied enormously and are doing much damage, especially in Florida.

Invasion of a carabid beetle.—Mrs. E. D. Kane, M. D., writes us from Kane, Pa., that she has been much annoyed by the appearance in her house of numbers of the small but very strong-smelling carabid beetle, *Nomius pygmæus*. So foul was the odor from the insects that defects in the drainage system were suspected, and the pipes were inspected. The beetles were probably attracted to the house at night by the lights.

An unwelcome insect imported via the World's Fair.—Prof. W. T. Trelease sends from Missouri larvæ and beetles which he states are very troublesome in cycads on a suburban place in St. Louis. They came in plants bought by the owner of the place at the close of the Chicago Exposition, and Mr. Trelease thinks were imported direct either from Australia or South Africa. The insect proves to belong to the Australian genus Tranes, family Curculionidæ, and is a dangerous addition to our insect fauna. Energetic steps should be taken to exterminate it.

The drug-store beetle damaging boots again.—Supplementary to the note upon pages 403–404 of Volume IV, of Insect Life, we have to record the receipt of larvæ of what is probably *Sitodrepa panicea* from the quartermaster's depot at San Francisco, Cal., where they are said to be damaging boots by boring into the leather near the straps, where an excess of paste was used, and also wherever the paste was dropped upon the boot. The ordinary bisulphide of carbon treatment was recommended.

Injury by the three-striped blister beetle.—In Volume IV of Insect Life, page 77, attention was called to the three-striped blister beetle (*Epicauta lemniscata* Fab.) and its injuries in potato fields and to cabbage. June 5 of the present year (1896) Mr. W. F. Colcock sent specimens of this beetle from Yemassee, S. C., with the report that it was injurious to potato vines, beet tips, and squash plants, and during August Messrs. W. T. Taylor & Bro. wrote that the alfalfa crop in the vicinity of Wharton, Tex., was a failure through the depredations of the same insect. September 4 we received specimens for determination, with the further statement that it did much damage to other vegetation.

Oreodera in the West Indies.—Mr. J. E. Duerden, acting secretary of the Institute of Jamaica, Kingston, Jamaica, British West Indies, sends us specimens in all stages of the longicorn beetle, *Oreodera glauca*, boring into sweet orange trees in Jamaica. The sending is of unusual interest, as it not only gives us a new orange-tree enemy, but from the further fact that of the 37 species of the genus Oreodera none has ever before been found in the West Indies.

A new locality for Bruchus obsoletus.—January 10 of the present year we received from Mr. G. H. Hicks, of the Division of Botany of this Department, specimens of *Bruchus obsoletus* Say and *Apion segnipes* Say, bred from the seeds of *Tephrosia spicata* collected at Titusville, Brevard County, Fla. *B. obsoletus*, it will be remembered, was long believed to be the name of the destructive bean weevil until 1892, when we succeeded in establishing the identity of the bean species with *B. obtectus* Say and *obsoletus* as the species that lives on *Tephrosia virginiana*. The latter was described from Indiana, and has been recorded also from the District of Columbia. The species and its food plant are figured in the Annual Report of this Department for 1892 (Pl. VII, figs. 2 and 3).

Hippelates flies and sore eyes.—The late Dr. James C. Neal wrote us from Stillwater, Okla., just before his lamented death, that in his experience in Florida Hippelates is a carrier of the virus of gonorrheal sore eyes from person to person, causing the epidemic form; but that if crushed in the angle of the eye a very violent inflammation of the lid, without pus, occurs. The body of the fly seems to contain an acid, probably formic, which causes great suffering to the unfortunate child that has, with some trouble, succeeded in crushing it in the angle of the eye. A week solution of sodium bicarbonate gives relief speedily in this case; in the former there is great danger of losing the sight by ulceration of the cornea.

Larvæ in the ear.—Dr. William C. Braislin sends us from Brooklyn, N. Y., specimens of maggots taken from the ear of a patient suffering from acute suppuration of the middle ear. They appear to belong to either Calliphora or Sarcophaga, and are quite unlike the larvæ of *Lucilia macellaria* and *L. cæsar*. The eggs are supposed to have been laid three days before the larvæ appeared; a supposition which, if it has any foundation at all, indicates that the patient was aware of the oviposition of the parent fly.

Early and new appearance of the horn fly.—Mr. M. Tandy, of Hancock County, Ill., writes us that the horn fly made its appearance in his vicinity about May 2, 1895. He believes this to be the first visitation in that particular locality. Mr. John W. Mansfield, writing from Essex County, Mass., states that the fly was first noticed in that neighborhood on the 7th of May.

Mr. I. W. Nicholson, of Camden, writes that this insect appeared in New Jersey earlier than ever before known. They were first observed April 30, and great annoyance to stock was expected during the season.

We have received specimens of this fly from Mr. A. L. Wilson, of Quincy, Fla., who says that it first appeared there in 1893.

Mr. W. W. Merriam sends us, under date of November 7, 1895, specimens of the horn fly from Twin Oaks, San Diego County, Cal. He gives a good account of their occurrence upon cattle, and inclines to the belief that they came on Texas stock.

A man-infesting bot.—In May, 1896, we received from Mr. J. R. Swinerton, manager of the Hotel Warwick, Newport News, Va., an œstrid larva taken from the arm of a sailor at Newport News May 11. The sailor stated that he was stung by an insect about six weeks previously in Brazil. The larva was nearly full grown and was living when taken from the arm. It was light in color, but turned brown and died before it was received in Washington. No further facts could be ascertained, since, in the interval between the sending of the insect to Washington and the receipt of a reply from this office, the man had disappeared. The larva was in fairly good condition and was sent to Dr. R. Blanchard, in Paris, who wrote us under date of June 5 that it was *Dermatobia cyaniventris*, known as the "torcel" or "berne." Dr. Blanchard's papers upon the Œstridae attacking human beings, in the Annales de la Société Entomologique de France for 1893–94, have shed a flood of light on this interesting and important topic.

An efficient flycatcher.—Mr. A. W. Butler, of Brookville, Ind., has sent us a specimen of *Bittacus pilicornis* Westw., which he says was one of a number of specimens which had attracted much attention at Brookville on account of their efficiency as catchers of flies. August 26 about 20 of them were observed in the office of the principal hotel in Brookville catching and killing flies.

Habits of Comastes robustus.—Specimens of this interesting bombyliid fly, which is a native of the Southwest, have been sent in by Messrs. M. B. Davis and W. E. Armstrong from Waco, Tex. They captured it hovering above the entrance to the nests of a species of Melissodes which has not yet been determined. It is likely that the bee fly is parasitic in the nests of the Melissodes.

A corn-feeding syrphid fly.—Mr. A. V. Sims sends us from Wenonda, Va., specimens of the syrphid, *Mesograpta polita*, the corn-feeding habits of which are noted in Insect Life, Vol. I, pp. 5–8. He reports it quite injurious to the corn crop.

Damage to chufas by Cyrtoneurus mutabilis.—We have recently received from

Prof. Gerald McCarthy, of Raleigh, N. C., and from Mr. Thomas J. Key, of Montgomery, Ala., specimens of the hemipterous insect known as *Cyrtoneurus mutabilis*, which, it is stated, is damaging chufas by puncturing the tubers.

A plant-bug on Russian apricot trees.—We have received specimens of *Leptoglossus oppositus* from a correspondent at Oakton, Va., who reports that the species is to be found in considerable numbers on his Russian apricot trees, both leaves and fruit being affected.

Chionaspis biclavis in Mexico.—Mr. Ehrhorn sends mounted specimens taken in Mr. Craw's quarantine work from a lime tree which had come from Mexico. This was in April, 1895. This insect might be very troublesome indeed on our citrus trees should it become established; the more so that it is very inconspicuous.

The hop plant-louse in Japan.—Among the many interesting facts communicated to this office by Mr. Albert Koebele, recently traveling in the Orient for the Hawaiian Government, is the statement that he has found the hop-plant louse, *Phorodon humuli*, upon plum, *Prunus communis*, in Japan, also upon Pajan hop, *Humulus japonicus*. The common commercial hop, *H. lupulus*, occurs in Yesso; but this plant was not examined by Mr. Koebele.

Abundance of a red mite in Arizona.—Mr. Herbert Brown sends from Tucson, Ariz., specimens of a red mite which he states are very abundant on the mesa a few miles south of the city. The species, as determined by Mr. Banks, is *Trombidium magnificum*. It is widely scattered over southern Arizona, according to Mr. Brown, and is said to be more abundant in the mountains. These insects are called "angelitas" (little angels) by the Mexicans.

Icerya purchasi not in the Azores.—Several statements have appeared in print of late to the effect that the fluted scale (*Icerya purchasi*) has appeared on one of the Azores Islands, and has been damaging the citrus plantations. We have learned from Dr. Francisco A. Chaves, of the Municipal Museum, Ponta Delgada, that this scale insect has not appeared upon any of these islands, and that the rumor arose from the fact that *Mytilaspis citricola* has been damaging orange trees on the Island of San Miguel.